SCIENCE EDUCATION

Formerly GENERAL SCIENCE QUARTERLY

SERVING TEACHERS IN ELEMENTARY SCHOOLS, JUNIOR AND SENIOR HIGH SCHOOLS, COLLEGES, AND PROFESSIONAL SCHOOLS FOR TEACHERS

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INTRODUCING THE CONTRIBUTORS

DR. DONALD W. KERST, Professor of Physics at the University of Illinois, is one of America's best known and promising young scientists. His invention of the betatron was one of the great scientific inventions in recent years. For this he received the John Scott Award established in 1816, and the Cyrus B. Comstock Prize, of the National Academy of Sciences. Dr. Kerst's first betatron went into operation at the University of Illinois, July 15, 1940. So full of promise are the possible applications of the betatron for human betterment that the Illinois state legislature has appropriated the almost unheard of (by a state for scientific investigation with one instrument in one field) sum of 1.5 million dollars for the construction of a 300 mev betatron and a laboratory to house it. The laboratory is now under construction. Dr. Kerst received a Ph.D. in Physics from the University of Wisconsin. During the war he spent more than two years on the Manhattan Project at Los Alamos.

DR. HENRY QUASTLER, with Professor Kerst, has been investigating the therapeutic effects of betatron radiations. His work in this field has attracted the attention of radiologists and physicists. He is a member of the staff of the Carle Hospital Clinic, Urbana.

Dr. Quastler graduated from the University of Vienna Medical School. He came to the United States in 1939.

MR. ROBERT STOLLBERG is Assistant Professor of Physics at Wabash College. He is a graduate of the University of Toledo (B.S. 1935; B.Ed. 1936), and of Teachers College, Columbia University (M.A. 1940). At present he is completing his work for an Ed.D. from Teachers College. During the war he spent over four years in the Navy, three years of which were at the Radio Materiel School, Treasure Island, California, as Senior Instructor in the electronics training program.

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PROFESSOR RALPH W. LEWIS is now doing research in the William G. Kerckhoff Laboratories of the Biological Sciences at the California Institute of Technology, Pasadena. He is on leave from the Biology Department of the Basic College of Michigan State College.

SCIENCE EDUCATION

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THE APPLICATIONS OF HIGH ENERGY BETATRON RADIATIONS

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THE successful operation of the betatron in 1940 was early enough to bring about its use in industrial work for radiography of metals during the war, but the fields of medical therapy employing the betatron and of nuclear research with the betatron have been examined only slightly during the recent years of war. The possibilities of achieving voltages of 250 million electron volts with the betatron were being examined very early in the war but the carrying out of the construction of such an instrument was postponed until recently. It is desirable for physical research to provide an instrument of at least this voltage because it can be expected that meson pairs will be produced if a quantum energy or an electron energy greater than twice the rest mass of a meson is available. This energy is sufficient to materialize into a positive and a negative meson, such as the mesons observed in cosmic rays, also the fundamental limitation of the betatron energy which will be discussed later is not a serious obstacle at 250 million electron volts.

For the war work mentioned above, it was desirable to provide an instrument giving radiation of the utmost penetrating power in iron and eminating from the smallest possible source so that sharp shadows could be cast. Both of these objectives have been achieved in the betatron developed under an OSRD contract for radiographic use. Simple predictions based on known behavior of electromagnetic radiation indicate that the first objective could be achieved by accelerating electrons to 20 or 30 million volts and employing the x-rays produced when they strike a target as the penetrating radiation. The theory of the absorption of x-rays in matter indicates that the most penetrating photon for iron has about 8 or 9 million volts quantum energy. More energetic photons are more strongly absorbed in iron. The reason for this is that at higher and higher quantum energies the Compton absorption process plays a decreasing part in the absorption of x-rays, while at one million volts and above the pair production process plays an increasing part in the absorption of photons by matter. The photon, if it has an energy in excess of one million volts, can materialize a positron and an electron by giving up one million electron volts of energy to provide the mass for these two particles and by giving the remainder of the quantum energy to the particles for kinetic energy. This pair production process accounts for most of the absorption above 10 million volts; and it has been experimentally verified by using the monochromatic x-rays at about 11 or 15 million volts that the higher energy x-rays are less penetrating than the lower energy x-rays. However, to generate the large number of photons having an energy in the 9 million volt region, it is necessary to have an electron energy much greater than 9 million volts. This is because the spectrum of x-rays produced by an electron

striking a target is a continuous spectrum having many low energy quanta and few high energy quanta. One must choose an electron energy which gives a sufficient number of the penetrating quanta and not too many high energy quanta which will be excessively absorbed. One must also not choose an electron energy so high that the x-rays produced by the electron will cause secondary pair formation in the iron, which, in turn, will produce very penetrating tertiary quanta. These tertiary quanta are expected to become objectionable for radiographic purposes somewhere near 40 million volts electron energy. However, the high energy photons, say between 10 and 20 million volts, have the very desirable property of not being absorbed much more strongly than 9 million volt photons, but in their absorption they disappear completely leaving practically no objectionable secondary or tertiary radiation. One expects that a betatron having an energy between 20 and 30 million volts for the electrons would be ideal for x-ray work in iron. That film fog from secondary and tertiary radiation is less at 20 million volts than at 10 or 15 million volts was established during the war and it has been recently shown that 20 or 22 million volt electrons produce the most penetrating type of "bremsstrahlung" that there is for steel.

The second desirable feature of a fine focal spot was fairly easily achieved because of the very fine beam of electrons which circulates in the betatron's orbit. A point source of x-rays as small as 0.010 of an inch high can be achieved and the radiographs produced by it are free from fuzzy shadows and can be enlarged several times during the x-ray exposure by separating the object and the photographic film.

Necessary practical features were worked into the manufactured instrument* to provide convenience and ease of operation. These are things such as simplified push-button controls, the very important permanently sealed-off porcelain vacuum tube and stability arrangements. With this type of betatron one can very easily take radiographs with a high contrast film through thicknesses of 14″ to 15″ in perfectly reasonable exposure times. Using a fast technique, pictures have been taken through 20″ of steel in 18 minutes.

The therapeutic application of the x-radiation from a betatron has been delayed by the war but ought now to proceed rapidly. The pioneer work of Dr. Henry Quastler on the nature of the biological reactions produced by betatron radiation and on the biological value of the r unit of x-radiation from a 20 million volt betatron shows that with proper caution and practice the therapeutic worker should be able to administer a dose of betatron radiation and obtain biological reactions which are fundamentally no different from those observed with a 200 kilovolt x-ray machine, but which are different in spacial distribution. If the Victoreen instrument is used for measuring the radiation, then the biological reaction seems to require 1.3 times as many r of radiation from a 20 million volt betatron as it would require from a 200 kilovolt x-ray machine. Studies of cross fire plots indicate that with 20 million volt x-rays one now should not be required to curtail an x-ray treatment because of radiation sickness produced in a patient. There is no reason to expect important differences in therapeutic value of x-rays from betatrons of various energies because at some energy a little below 20 million volts the volume dose should already be tolerable to the patient.

Of the physical experiments which can be done with the betatron, one of the easiest is the photodisintegration of nuclei by gamma rays. It is merely necessary to place a sample of material in the x-ray beam and in general it becomes radioactive through the ejection of a proton, neutron or alpha particle. Photoelectric thresholds for a stable nuclei are expected to be between 6

* These betatrons were manufactured by Allis-Chalmers Manufacturing Company.

and 8 million volts; however, photoelectric thresholds leading to radio-active results require more energy. Radioactivity produced in the targets which are bombarded by the electrons has been observed and a large field of untouched investigation is now open since 20 million volts is sufficient to disrupt practically all nuclei.

The study of mesons produced in a laboratory is, of course, the most obvious reason for desiring higher energy betatrons. It is the reason for the Mark III betatron design which went to 100 million volts and it is the reason why it is desirable to produce meson pairs which require around 250 million electron volts. The possible limitation to the energy which one can acquire with the betatron is due to the fact that the rotating electron charges radiate electromagnetic energy since they are accelerated toward the center of the orbit. Calculations by Serber before the first betatron was built indicated that with a ring of randomly spaced electrons one would expect an individual electron to lose only 5 to 10 electron volts energy during acceleration in the Mark I betatron. The analysis applied to higher energy instruments indicated that at 200 or 250 million electron volts this radiation may produce a contraction of the orbit which could be tolerated but which becomes increasingly objectionable at a still higher energy. The Mark II betatron which operates from 20 to 24 million volts is calculated to have a loss of approximately 1 kilovolt due to radiation. There are numerous ways of minimizing the energy loss which will be employed when going to energies of the order of 250 million volts. These are primarily expansion of the orbit while the magnetic field is still increasing, and a continual addition of flux within the orbit to compensate for the energy lost by radiation.

POSSIBILITIES OF THE BETATRON IN CANCER THERAPY

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IN THE preceding paper, the betatron and some of its physical and technological implications are described by the inventor, D. W. Kerst. In this article, some possibilities of using the betatron in cancer therapy will be discussed. The author wishes to state clearly that he is talking of possibilities and not of realities. At the time of writing (December, 1946), no betatron is available for clinical use, nor is there any hope of one being availabe in the immediate future: none of the few existing machines could be used on patients without some adaptations; therefore, no definite judgment about the role of the betatron in cancer therapy can be given.

However, two facts are known which permit a fairly accurate prediction. The first is of a physical nature: high energy rays as produced by the betatron are more *penetrating* than those of conventionally used energies. The second fact rests on biological experiments: the elementary responses in tissues of animals and plants—and, presumably, of human beings—are the same for high and low energy radiations. Therefore, we can assume that the betatron will produce therapeutic effects comparable to those obtained with conventional roentgen rays, or with Radium, with the difference that the distribution of dosage and, consequently, of elementary tissue reactions, will be changed because of the better penetration of the high energy rays. In order to evaluate what this may mean we have to consider the general principles of radiation therapy.

Cancerous tissue can be destroyed by radiation only if it absorbs a sufficient amount of radiant energy. Any portion of a cancerous mass is largely independent, and destruction of some portions of a can-

cer has little effect on the remaining portions. It is necessary to get radiant energy absorbed throughout the whole cancerous region, and this means all places evidently cancerous plus a certain neighborhood where—on the basis of past experience—we have reason to believe that cancerous tissue is already established without being yet clinically manifest. The cancerous region always contains cancer tissue, which should be destroyed, and normal tissue, which must be preserved. Both kinds of tissue receive the same amount of radiation. Fortunately, many cancers are more susceptible to radiation damage than the neighboring normal tissues. The difference in susceptibility is often small, but in many cases one can determine a dosage of radiation which combines a fair chance of destroying the cancer with a tolerable degree of damage to normal tissues. This dosage, now, has to be distributed evenly throughout the cancerous region.

Let us consider the distribution of radiant energy absorbed from a single beam of roentgen rays. With conventional rays—produced at about 200,000 volts—the highest concentration of energy absorption is found at and just below the skin. As we proceed into the depth of the body, the concentration of radiant energy absorbed decreases; at a depth of three inches, it is reduced to about one-half of the highest value; at six inches, it is down to one-fifth. Therefore, whenever we treat a deep-seated cancer, only a fraction of the total energy absorbed gets to where it is needed, and the highest dosage occurs not in the cancerous region but in the skin. The situation can be considerably improved by using, instead of one beam, several beams, administered in succession from different sides. By shrewd methods of "cross-firing" the dosage distribution can be made much better; still, in the great majority of cases, one can not deliver an effective dose to the cancerous region without causing some damage to the skin, and without making the patient absorb a good deal of useless and harmful radiant energy outside the cancerous region. In a number of cases, skin damage or the general reaction to the total amount of energy absorbed threaten to become serious or even fatal, so that the treatment must be interrupted before an effective dose has been administered to the cancer.

The distribution of radiation dosage is much more favorable with high energy rays. The highest concentration of radiant energy absorbed is not found on the surface but inside the body, and the dosage is fairly even throughout the region traversed by the beam. This will yield two advantages: (1) a higher percentage of the total energy absorbed will go into the cancerous region, and (2) it will not be necessary to apply a heavy dose to the skin in order to get an effective dose into the depth. By choosing judiciously several beams for cross-firing, it will always be possible to irradiate any localized lesion anywhere in the body with an effective dose, without either using a dangerously high amount of total energy, or too high a dose on the skin. Thus, two factors which limit the size of the dose administered to the cancer—which is tantamount to two causes of therapeutic failure—should disappear. The third limiting factor, unfortunately, the most important one, will remain unchanged: this is the presence of normal tissues within the cancerous region. These normal tissues receive necessarily the same dose as the cancerous tissue, whatever the quality of the radiation used. The postulate to keep them reasonably intact puts a limit on the dose which can be applied to the cancerous growth.

In conclusion, then, we have no right to expect that our results in cancer treatment will be improved spectacularly once the betatron is used in clinical work because, with any type of roentgen rays, we cannot put a higher dose into cancerous tissue than the normal tissues in the immediate neighborhood will stand. But, there should be some increase in the number of cures be-

cause we will be able to eliminate all the failures which are caused by threatening radiation damage in normal tissues outside the cancerous region. Moreover, we should be able to avoid a good many of the complications which attend radiation therapy. These two achievements, which we can confidently expect, will constitute a limited but very definite gain in our fight against cancer.

THE PLACE OF ELECTRONICS IN GENERAL EDUCATION

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PRIOR to the war that has just ended, electronics in general education was limited to the offering of an occasional elective course in radio at the high school level, and to haphazard treatments of the subject within more traditional units on electricity, or to communication in courses on general science or physics. In the vocational schools, of course, there were bonafide courses in radio construction and/or repair, but workers in general education eyed them with the same sideways glances as they did printing, auto mechanics, and woodworking shop. In addition, there were numerous hobby clubs built around the general subject of radio and aimed at a wide variety of levels. By and large, however, the public's attitude toward efforts at electronics education was typified by their contempt for the advertisements on the back covers of popularized science magazines: "Be a Radio Expert in Ninety Days" and "Earn Big Money in Your Spare Time".

But the field of electronics has made tremendous strides in the past half-decade, and the influence of the war has greatly emphasized this growth in the minds of thinking people of all ages. A few facts have been released about radar, and the reading public waits impatiently for more; the corner around which television has been lurking seems nearer than ever before; flamboyant advertisements in many magazines allude to "the breath-taking fidelity that is Frequency Modulation"; new and better phonographs and radios are promised; private citizens anticipate the use of personal "handie-talkie" intercommunication sets; artificial fever is induced, woods are seasoned, garage doors are opened "with the aid of" electronics; and many persons harbor the hope that electronics may eventually provide a defense against the atomic bomb. Surely, if human needs and interests are to be criteria for the subject matter and method of functional schools, the time has come to reassess the place of electronics in general education.

Anyone who ventures to initiate a conversation concerning electronics in general education is almost certain to elicit a battery of questions such as: What is electronics, anyhow? Why is there this sudden emphasis on electronics now, when we have had radios for a generation or more? What contacts do modern people have with electronics in their daily living? What can acquaintance with electronics contribute to modern young people? What is the place of electronics in today's schools? Before the electronics enthusiast can continue with his subject in the presence of a discerning group of listeners, he must make reply to these inquiries.

WHAT IS ELECTRONICS, ANYHOW?

Unfortunately, most writers and authorities in the field of electronics have not taken time out to specify exactly what their field includes. For purposes of the pres-

ent discussion, the following definition is suggested:

> "Electronics is that branch of electricity which is concerned with the flow of electrons through an enclosed and partially evacuated space."

Such a definition is seen to be closely affiliated with "vacuum" tubes and gas-filled tubes, and includes such applications as radio, radar, television, thyratron control circuits, X-rays, mercury vapor lamps, fluorescent lights, and electron microscopes. On the other hand, it is seen that it excludes such applications as incandescent lights, simple telegraph and telephone circuits, the aurora, electromagnetic radiation and simple crystal receivers. However, because they are so closely allied with communications, the most important application of electronics today, some materials related to electromagnetic radiation and to sound will be considered in this discussion also.

WHY IS THERE THIS SUDDEN EMPHASIS ON ELECTRONICS AT THIS TIME?

While it is true that radio has been with us since before the twentieth century, its tremendous expansion in the last half decade has been nothing short of phenomenal. Accelerated largely by the war, the electronics industry, as early as 1943, reached the four billion-a-year mark —larger than the entire pre-war automobile industry.[1] Many observers firmly believe that post World War II years will do for the electronics industry what post World War I years did for the automobile industry, and that the years of the immediate future will be dominated by electronics to a degree comparable to that in which the years of the immediate past have been dominated by automobiles. The sudden emphasis on electronics at this time, then, is due to the rapidly expanding role which it is assuming in our everyday living.

[1] For an excellent treatment of the wartime boom in electronics, see *Fortune* magazine, July, 1943.

WHAT CONTACTS DO MODERN PEOPLE HAVE WITH ELECTRONICS IN THEIR DAILY LIVING?

A decade ago practically the only electronic devices well known to the average citizen were the radios in private homes. Today this radio has not only been vastly improved, but has as running mates in the home and office electronic phonographs, television, facsimile reproduction, electronic dictaphones, FM radio reception and electronic intercommunicating sets. Many persons today have as much contact with induction heating, industrial electronic controls, photoelectric devices, X-rays, etc., as they did with their household radio sets a dozen years ago. The press has responded to its readers' natural curiosity by bringing the military applications of electronics into public gaze. All of us have new electronic gadgets we can build if we so desire, multiplied dozens of devices to buy and/or enjoy, and we realize that there are important new concepts and understandings we might profitably possess. Whereas the average citizen of several years ago had no more than a passing contact with electronics, today finds people of all ages and most walks of life acutely aware that a great and relatively new field of science has grown up around them and is permeating their everyday experience.

One of the most important aspects of this growth of electronics is in the field of communications, particularly in the form of broadcast radio. For the first half of its existence, since its inception a scant half-century ago, the science of radio communication underwent slow development, and was little known to the general public. In the last generation, however, radio has emerged from its status as an odd looking and worse sounding gadget in the enthusiasts' workshops to full status as an almost indispensible household necessity. Few modern homes are completely without receivers; many possess several sets.

The radio broadcasting system which

is characteristic of modern America has a tremendous influence on American society in such ways as dissemination of news and opinion, discussion and propaganda, and as a voice for certain vested interests. In addition to this impact on society, broadcast radio affects individuals as it provides them with entertainment and information, and as it furnishes vocational openings in such fields as radio salesmen, engineers, program artists, manufacturers, skilled laborers, and the like.

WHAT CAN AN ACQUAINTANCE WITH ELECTRONICS CONTRIBUTE TO MODERN YOUNG PEOPLE?

The student of today is the citizen of tomorrow. Almost until the present, electronics has not figured very heavily in matters of social control. Recently and currently, however, some nations have considered or put into effect governmental operation of all broadcasting, and labor jurisdiction in electronics service is becoming a public issue. Federal control of "airspace" occupies an increasingly important role, and if radiant energy on commercially practical power scales ever becomes a reality, national control of broadcast energy will be an issue of far-reaching import. Indeed, in certain aspects of electronics, socialization of services seems almost inevitable. To the extent that the citizen of tomorrow has a basic understanding of electronics, he will be better able to participate in the administration of his government.

The student of today is the wage-earner of tomorrow. With the rapidly multiplying number of jobs and professions involving electronics, it is important that young people be given a glimpse of the field, see it shorn of its mystic difficulties, witness its future vocational possibilities, so that they can include electronics in the field of vocations from which their choice will eventually be made.

The student of today is the consumer of tomorrow. Already there are numerous electronic devices, and tomorrow's citizen will be a more intelligent consumer if he knows the basic principles of operation, cost of operation, personal hazards, and standards of performance of the devices he contemplates buying.

The student of today needs understandings—today and tomorrow. Every individual is his own philosopher; he seeks and acquires an understanding, correct or otherwise, of the nature of the world in which he finds himself, and hence of his own place and importance in that world. This world picture includes a conception of the macro- and micro-cosmos, both in terms of time and space. Since electronics deals with the structure and behavior of matter, it contributes toward this end. Also affiliated with electronics are other everyday physical concepts, such as voltage and current, energy and power, and the nature of sound and hearing.

The student of today has appreciations—today and tomorrow. The lives that people lead are made rich by the enjoyments and appreciations they experience, among other things. A study of electronics will contribute toward an appreciation of the long path that man has trod—and has yet to pursue in the understanding and control of his environment. A richer appreciation of the luxuries of modern life can also be realized; the little girl who "listens to the program through the courtesy of the little electrons" has a richness of experience not shared by her less informed fellow-listeners.

The student of today has hobbies—today and tomorrow. While there is no evidence that the "ham" radio operator is declining in numbers, the present day trend of electronics hobbies is more towards high fidelity audio reproduction and broadcast receiving, disc, film, or magnetic wire recording of speech and music, collections of phonograph records, and radio controlled airplanes, alarm clocks, and garage doors. If students are introduced to the subject of electronics, they will possess a

wider field from which they can select an enjoyable and often-times lucrative occupation of their leisure time. To some individuals this sort of activity is as intriguing and as satisfying as going to the movies, reading a good book, playing bridge or golf, attending the theatre, raising flowers, or listening to great music; and who is to say that it is less worth while?

WHAT IS THE PLACE OF ELECTRONICS IN TODAY'S SCHOOLS?

Within the framework of general education, the point of entry into the modern curriculum is seen as being possibly three-fold:

I. Virtually every youngster now takes a required course in general science, commonly in the ninth grade, and often preceded by others in the seventh and eighth grades. It seems fitting that electronics should be presented in this required course (ninth grade) either as a unit in itself, or as a very real part of a unit on electricity, or perhaps one on communications. This unit might include as a minimum some idea of the nature of electron flow, radiation, vacuum tube amplifiers, and the scope of electronics.

II. Many high school students, college preparatory and otherwise, take a course in senior science, physical science, or physics. Such courses should also include work in electronics, but at a higher level than mentioned in (I). This work could include simple circuits used in amplifiers or radios, concepts of electronic control devices, simple electronic networks, and some suitable laboratory work in actual construction.

III. A small but definite group of high school students may be found who are interested in electronics to a greater degree than that mentioned in (II). In a school of suitable size, there might be available a one or two semester course in electronics. This could be designed so that it would meet the laboratory science requirement for college entrance, and still provide a background for young people who are interested in electronics either as a vocation or as recreation. This is not to be confused with a vocational or industrial arts course in electronics. It is still a part of general education.

If the questions cited at the beginning of this discussion are typical of those which confront the enthuiast about electronics education, and if the replies to them have been well-conceived and clearly outlined, the next task in which he should engage is that of suggesting ways and means in which some of the desirable outcomes of electronics in general education may be realized.

HOW TO WRITE LABORATORY STUDIES WHICH WILL TEACH THE SCIENTIFIC METHOD *

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THE problem of teaching scientific thinking is still unsolved despite the monumental work of John Dewey and the work of his predecessors and successors. There is little doubt that high school teachers have made better attempts at solving this problem than most teachers at the college level. Yet, it seems that the greatest advance in the teaching of the scientific method will eventually be made in college teaching because of the better facilities available and because of the greater proportion of research trained teachers. This will occur only, however, when the orthodox descriptive methods begin to give way and when those in the vanguard have

* Contribution No. 3 from the Dept. of Biological Science, Michigan State College.

conclusively demonstrated that factual material is more readily and more meaningfully taught when it is carried in the framework of problems based on the fundamental steps of scientific thinking.

Despite the fact that the broad outlines to the problem of teaching the scientific method are well drawn up, there is a dearth of material at the applied level. The day-to-day teaching of the scientific method has evidently been carried on orally by most teachers in college for one searches almost in vain for laboratory manuals which go beyond the descriptive phases of the science. When large numbers of students are being taught by a large staff, it becomes almost imperative that the methods which have been used orally be organized and recorded so that there is a basic pattern to be followed by all the different sections of the course. In writing laboratory studies the author has developed and used a set of rules which may be of value to others who are struggling with this problem.

It is presumed that the reader is well acquainted with the descriptions of the scientific method, and it is hoped that the reader has participated in it to the extent of having formulated, tested and published at least one hypothesis. One may, however, use the following rules without this knowledge and experience, but they can be applied with greater ease after one has struggled through the steps in the scientific method in his own research problem.

The first rule: list all the topics you would like to cover in one unit of laboratory work and under each topic list all of the facts which should be brought out. Make this list as complete as possible, but do not let it become the ruling force in the development of the study. Allow yourself complete freedom in the selection of any material in this list according to its utility in building up situations for scientific thinking.

The second rule: assume that the orthodox treatment of the subject to be written is not good and resolve that it will not be used. Without this rule always kept to the forefront you will find the heritage of previous generations guiding with such a strong hand that an original approach will be crowded out. It is not necessary to bow to heritage for, in the population of knowledge, mutants are everywhere waiting to be observed. After a mutant idea is developed the rule may be relaxed and considerable use made of the orthodox material which, in the presence of the mutant, may take on new and useful characteristics. As a part of the second rule one should discard from his thinking, at first, all of the usual laboratory procedures and resolve not to use them until a period for incubation of new ideas is past and until the literature not generally used by writers of laboratory outlines has been perused.

The breaking away from the orthodox is as difficult and painful here as it is in all phases of individual and collective human development. The third rule supplies a diversion from, if not an anesthetic for, some of this pain: write the laboratory studies in or near a laboratory where new ideas can be tested immediately. There is something about actual laboratory manipulation which brings out new ideas. Maybe the physical activity necessitates a relaxed mind and in this state the mind is less subject to habitual associations. No matter how this rule functions, the fact remains that it is extremely useful and, consequently, no laboratory study should be written without a careful working through of all of its parts in the laboratory.

The fourth rule follows out of necessity: take plenty of time to write a laboratory study. No matter how much you desire to implement the teaching of the scientific method, it is better to spend a whole year on a single study than to kill your enthusiasm for a new approach by using a hurried outline. Even the best is poor enough in the light of future experience. One should

never be discouraged by a slow start for once the lag phase is passed, growth is geometric. By taking plenty of time one can avoid the pressures of a deadline which in general force one back to orthodox methods. To originate a new approach and to develop two or three new techniques is a Herculean task. It is best to develop one laboratory study at a time until the approach is mastered.

If one can follow the rules thus far laid down, the next four are less difficult. Rule five: present the facts to the student which are to be the basis for his thinking. The facts may be presented in a number of ways. The author prefers, when possible, to present facts as results of experiments performed by the student. On the highest level of scientific thinking this approach is inefficient because all experiments should test hypotheses already in mind. The best thinkers rightly deplore the miscellany which results from experimentation without a preceding period of careful and thorough thinking, but the violation is excusable here because it does yield facts, it generates interest, and above all it teaches techniques which are used when the "legitimate" step for the use of experimentation does develop.

Often it is impossible to present the kind or quantity of facts desired by this method. Observation of demonstrations is a good and often necessary method of presenting facts and if used sparsely in combination with experimentation it gives good results. Actual observation of specimens in the biology laboratory gives such a world of factual material that the difficulty becomes a matter of restricting and guiding the collections of the facts from these observations. When possible it is desirable to use facts which are already in the students memory. This is difficult to do because of the varied backgrounds of the students, but has been used with success when these facts are indirectly or directly recalled to the students mind. In other situations it is necessary to present facts verbally or in writing. All possible combinations of these methods of presenting facts can be used, and the choice will be determined by the subject and the manner of approach.

Rule six follows as the next step in scientific thinking: have the student state a hypothesis or hypotheses which interrelate the facts presented with something as yet unknown to the student. This rule at first is a tough problem for the author while writing and for many students when working through a laboratory study. If the author will allow himself to blunder through this step the first time, he will find that when he actually teaches the material from his first imperfect outline a dozen new ideas will be suggested. Students by their unexpected answers will point the way for much revision. Colleagues, without the preconceptions of the author will be an even richer source of excellent suggestions for revisions. After having taught from the first outline, the difficulty encountered with rule six is not a searching for ideas but rather the problem of choosing the best of many good ideas.

It should be kept in mind that a hypothesis is a tentative conclusion and as such has only two requirements: that it be logical and that it be based upon the facts which have been brought out in the study. To be a correct answer to the situation the hypothesis need not be true; it needs only to be logical and well founded. This will surely lead both teacher and student into many difficulties, for now the value of an answer depends not upon rote material, but upon the ability to think and to imagine.

In general more than one hypothesis should be required from a situation. One of these will probably be the text-book answer if such is available, but the others can come only from the student's own thinking and the basis of their merit is the logical thought which has gone into their formation. By requiring more than one

hypothesis the student is put into a situation which is novel to him, in which a pat answer will not rescue him from mental turmoil, and from which considerable dissatisfaction arises. He must be taught that mental confusion is a natural and necessary state which usually precedes good thinking. Here, too, the student must be taught that the function of the laboratory is not merely to illustrate the text and lecture material, but rather to teach scientific thinking. This, however, is too far from the present theme and will be discussed in a later paper.

One thing more should be added before going to the next rule. When students first encounter the problem of formulating hypotheses, the path should be made quite simple by leading statements, by leading questions, or by a brief review of the facts. After they have become accustomed to the over-all method of approach, the difficulties can be increased as the course progresses by increasing the breadth of the inference leaps and by requiring more hypotheses for each situation.

Rule seven: have the student choose the best hypothesis and test its validity. This rule is so important that unless it is carried out one cannot truly say that they are teaching the scientific method. This rule is the most difficult of all to implement. Preferably it should be carried out by allowing the student to devise and perform an experiment, but any situation which allows him to collect critical facts by his own observation will serve the purpose. The materials, methods and equipment used for the presentation of the original group of facts can now be used by the student in different ways to test his hypothesis. Often a simple experiment suggests itself automatically; at other times hints or suggestions concerning additional material may be necessary.

For some situations demonstrations may be used for presentation of facts to test hypotheses. In others it is necessary, but certainly less desirable, to give additional facts orally or in the laboratory study. When the latter is done, it is better to describe and give the results of an experiment than to give the facts without their source. Occasionally students can be required to outline an experiment which it is impossible to perform in the laboratory. This can be carried even further by having them record the probable results and to evaluate their hypothesis in the light of these hypothetical facts. Any number of schemes for the testing of hypotheses can be devised, but whenever possible the student should outline and perform his own experiments. This teaches him to reason deductively from his generality in order to decide what fact will test his hypothesis, to develop in his imagination an experiment to get at the fact, and to then use the fact gained from the experiment in his inductive thinking to decide on the validity of the hypothesis.

Rule eight is simply to have the student accept, restate in a modified form or discard what he chose as his best hypothesis. This accepted hypothesis or restatement should, as should the statement of all hypotheses, be brief, complete and gramatically sound. Usually one, well constructed sentence is sufficient and more is undesirable.

The path outlined by these rules may be followed in any number of ways. The whole of a laboratory period may be occupied by the formulation and testing of a single hypothesis or the work may be broken up into smaller units whereby more than one hypothesis is dealt with. The study may be constructed so that the successive hypotheses are dependent upon the preceding ones, or hypotheses may be independent as the study proceeds and brought together finally in all overall consideration of the problem.

All of this material will be made more concrete and, it is hoped, clearer by an analysis of a laboratory study written on the basis of these eight rules. This analysis will appear at a later date.

BUILDING AN OPAQUE PROJECTOR WITH OVERHEAD PROJECTION

C. A. BEACHLER
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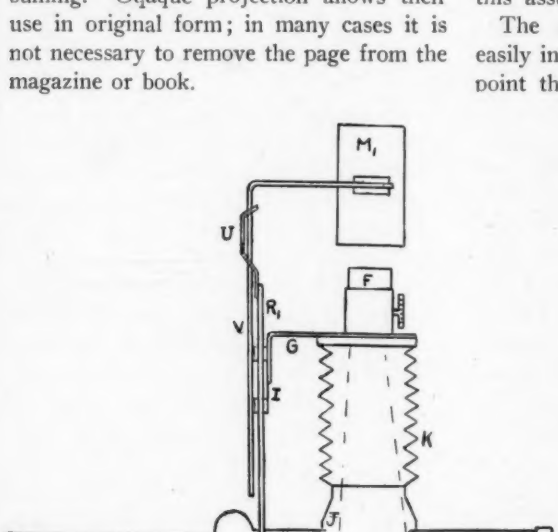
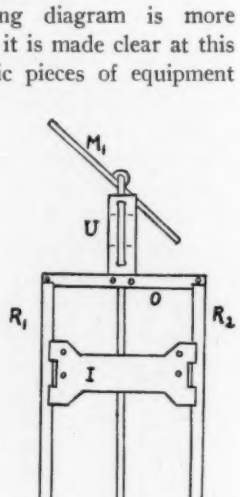
ONE of the most available groups of visual materials is that collected by pupil and teacher in the form of illustrated clippings from the newspaper and magazine page. Reproduction of these on film or slide is beyond the capacity of many laboratories and is, at the least, time consuming. Oqaque projection allows their use in original form; in many cases it is not necessary to remove the page from the magazine or book.

Overhead projection has additional advantages: the projector may be permanently located at the front of the room in convenient reach of the teacher; and it allows, with proper focusing, a fixed screen before the class so located that it disturbs no other demonstrations. Because of the convenience, materials that the pupil has taken time to collect are brought to the group attention. The pupil feels repaid for his efforts and is encouraged to continue his search, all the while evaluating these collections more intelligently because of this assured recognition.

The accompanying diagram is more easily interpreted if it is made clear at this point that two basic pieces of equipment were adapted to build this opaque projector. The first device was a slide projector which was one of the earlier models. From this were secured the lamp house and its base, and the projection lens and bellows. The second device was a discarded 35 mm.





motion picture projector. From this were secured the compartments holding the mirror, the unit supporting the projection lens, and other minor parts.

The steps in construction and assembly are given in order.

1. The bellows and projection lens of the slide projector were removed. A platform was set up in front of the lamp unit at the exact height at which the clipping, P, was to be placed. This level was determined by the lower position of the steel slide-frame holder, S. On this was fastened a model of the compartment, C, made from cardboard. This helped to hold the mirror, M, while positions and distances were determined for it. The remote end was opened, and a large aperture was cut in the top so light could reach the projection lens, F.

2. The focal length of this lens was determined by test. The lens assembly was supported over the box by a ring stand; thus its position could be changed in any direction.

3. The projector lamp was turned on in the dark room. The mirror was set in the compartment, tipped, and moved forward and back while the printed clipping, P, was observed. This served to determine the relative effect of these positions and angles in fixing an area 6″ square of maximum light intensity on the floor of the compartment. The position of the lens was changed to keep it over the center of the clipping which was also being moved. All positions—those of the mirror, the lens, and the top and bottom openings in the compartment—were recorded carefully. It was also found that the removal of one of the condensing lenses gave a more satisfactory condensation of light.

4. The cardboard model was removed and the metal compartment was cut to the same dimensions. Top and bottom slots were cut so the compartment would slip over S completely. This framework, S, which previously held the slide carrier, was a sturdy square. It was chosen for the structural foundation, to which was bolted the compartment and the lens supports.

5. The rectangular opening, 5″ x 5″, at the top of the compartment was reenforced by a receiver, J, for the lower end of the bellows, K. The bellows was suspended from the projection lens assembly. The mirror, M, of silvered plate glass was cut and fixed into position. The back of the mirror was protected by cardboard glued in place.

6. Slits were cut in the top of the compartment to accommodate the plated steel supports, R_1 and R_2, which carry the slide, I. This slide may be adjusted for height. The supports were bolted at the bottom and a cross member, O, was fitted at the top.

7. To the slide, I, a sheet of galvanized iron, G, was bolted at the four points indicated. The sheet was bent to a right angle and was shaped to fit the projecting lens support. A hole 3″ in diameter was cut out below F, to allow free action of the lens mount and to provide for the upward passage of light.

8. For the mirror support a piece of plated steel, U, bent as indicated, was bolted to the crossmember, O. Holes were previously drilled in the ends to allow the ¼″ rod, V, to pass through.

9. The mirror M_1 has dimensions of 4″ x 6″. It is also of plate glass. A tin case was fitted over it, crimped to the depth of the mirror on each edge. Four small rectangular tabs which were left on the tin sheet when fitted were turned over the mirror to hold it. Another piece of light metal was shaped like a shallow "U" and was bolted to the mirror case. The rod, V, was bent at a right angle. The position of the mirror could thus be adjusted as desired.

10. The table, T, is of three-layer plywood. Its dimensions are 8″ x 10″. A piece of metal was bolted crosswise at the center. Its ends were bent to a right angle.

A rigid framework, Y, was fitted to straddle the stand, E, and hinged at the back of the stand at Z. A strong spring, bolted to the bottom of Y at Q, and held above by the crossrod under S, held the table in position so that the material to be projected may be placed easily in proper position on the table. The edges of the table were painted black except for a square area whose sides were 3" from the point P, directly under the lens. The top of the table and the edges were stained to prevent soiling; the bottom was painted black. The inside of the compartment was painted white to reflect light, and the outside was enameled black to match the lamp unit.

In this conversion, the slide projector was not incapacitated for its return to its original form if ever desired as such. This is unlikely because this promises to be a better slide projector with overhead projection. On the receiver, J, is to be mounted a simple removable slide table, accommodating the commercial slide or the ones handmade from inexpensive slide-cover glass. The projector will rock backward on the axis below S, and this will allow easy access to the lower part of the compartment above the table. So, mounted on the table, will be placed a unit carrying a mirror M_2, facing the path of light from the lamp, and set at an angle of 45° to it. Light will be reflected upward for the slide projection. For this purpose upward adjustment of the lens, F, and the mirror, M_1, has been made possible in the above construction. If another condensing lens immediately below this slide table is necessary, one removed from the lamp unit is available and it can be readily mounted on the ledge of the opening in the compartment under J.

Thus we have a more usable slide projector for an expenditure of about fifty cents for the mirror. This amount includes cutting the mirror to size and grinding the edges. From the old 35 mm. projector we secured an excellent set of mounted B. & L. condensing lenses. These were originally set just behind the film gate which was preserved, too. It will be a comparatively simple bit of further adaptation to attach this condenser below or within J, and fit the gate assembly at the original distance and position above the condensing lenses. With the mirror unit used for slide projection, we then have an overhead film strip projector.

The time spent on the completed construction was about forty hours of interrupted short periods, and in a laboratory where work shops were widely separated. So we may charge about two or three full days of enjoyable labor to the acquisition of a valuable teaching aid, and the addition made to a teacher's experience is inestimable.

SCIENCE AND HUMAN WELFARE

IVOR B. N. EVANS

TEN years ago such a conference of scientists as was held at the Beaver Hall, London, England, from February 15–17, 1946, would have been thought impossible. Men with famous names and many rank and file scientists from varied countries discussed how science and the scientist should serve mankind. Chemists, biologists, physicists, engineers and many other kinds of scientist have realized the social effect upon the world created by their work. Two years ago no fierce, swift scientific event like the atomic bomb had brought them, suddenly, face to face with the ordinary, homely man and woman.

The Conference was held under the auspices of the 18,000-strong scientists' trade union—the Association of Scientific

Workers, in collaboration with the 30,000-strong union, the Institution of Professional Civil Servants, the British Association of Chemists, the Association of University Teachers, the Physical Society, the Nutrition Society and the Institution of Electronics. Though organized by two trade unions, it represented the opinions of many learned societies. Scientists from the U. S. A., Holland, France, Poland, Canada, China, India and South Africa were unanimous that it was essential that atomic energy be supranationally controlled.

EUROPE'S BLACK SHADOW

An ominous, black shadow has touched Europe, and the gaunt figure of famine is about to stalk through the Continent. Though many analyzed its causes, all came to the same conclusion—nothing can be done to turn it away, apart from mobilizing scientific opinion to secure the most equitable food distribution. The famous radar scientist, Sir Robert Watson-Watt, regretted they had no "immediate regime for the patient."

It was evident that the gap between the natural sciences and the social must be narrowed, as well as that between science and the humanities. Scientific method must be brought into general education.

The President of Britain's Royal Society, Sir Robert Robinson, chairman at the first session—"Science and World Needs," said, "In scientific affairs we are all socialists." Organization did not mean control but coordination, fostering independent thought and action.

Britain's Lord President of the Council, the Rt. Hon. Herbert Morrison, M.P., under whom are the Department of Scientific and Industrial Research and the Medical and Agricultural Research Councils, spoke for the Government.

"The world needs," said Mr. Morrison, "more scientific thinking, more widespread thought and . . . honest, factual thinking." He blamed society for the scientist's disinterestedness in the development of his work. "There has been too little imagination and understanding by governments, industries and other powerful influences of the value of scientific work." After mentioning the much improved financial help by the British Government to industrial research, he continued, "In Britain today we are starting to reorganize our affairs . . . in a planned, tidy manner. We are determined to organize so that no crumb of scientific knowledge, which might benefit the community is wasted. Britain is not rich in raw materials; but she is rich in men and brains. We have proved to the world that we can be good at applying our scientific research. We must keep science free and unchained." He added, "But we need over the whole field of science a combination of freedom, initiative and social service. He would be a foolish man who tried to set a limit to our material, intellectual or spiritual development."

Dr. Tu Chang Wang, after drawing attention to starvation in the midst of plenty, said that social scientists must be enlisted to put things right at the distribution end. He paid great tribute to Dr. Joseph Needham's work in helping to develop China's science.

Professor J. Burgers of Holland called for freedom to travel, removal of secrecy and easier telephonic communication between nations. Dr. John A. Simpson, representing the Federation of Atomic Scientists said that only a supranational body could secure control of atomic energy. The bombs, he concluded, could not be secretly made, for such activity would be difficult to hide. There should be an international atomic laboratory (proposed also last December in the British scientific magazine "Discovery"). Dr. H. McNeill of the O.S.R.D., said that through World War II, U. S. government research had increased tenfold.

Dr. C. P. Snow, Scientific Adviser to the Civil Service Commission presided over the second session. Dr. Stephen Taylor, M.P., foresaw great progress soon in the

biochemical and psychiatric aspects of medicine. He mentioned the use made by the British Army of psychiatrists for personnel selection and aptitude testing, and the electro-encephalograph for detecting mental abnormality, while convulsion therapy and prefontal leucotomy offered good prospects for improving certain abnormalities. He also stated that another 10,000 doctors were required for everyone to have an annual complete medical examination, and that the doctor must be regarded as a scientist, not a magician.

PEASANT METHODS

Dr. H. L. Richardson, Agricultural Adviser to Britain's Imperial Chemical Industries, said that until medicine brought birth-control to backward countries, agriculture must be made more scientific to feed countries like India. The peasant methods of India and Russia yield but 8 to 10 bushels of wheat per acre, scarcely higher than in the Middle Ages. The British figure is now 35 bushels. "It is a scientific certainty," he said, "that in India and China the production of food crops can be increased by at least 25 per cent by the introduction of modern scientific methods."

The British nutrition expert, F. Le Gros Clark, emphasized that though we could calculate exactly how many millions would die from famine, we could do nothing to stop it. Professor E. M. L. Oliphant suggested that the dwindling phosphorous world reserves might be augmented by transmuting aluminum. The use of atomic bombs, he continued, was now out of the hands of the scientist, and the politician and military men's concern. Britain has, he emphasized, greater need of atomic energy than the USA, with its vast supplies of coal, oil, and water power.

HIPPOCRATIC OATH

Sir Alfred Egerton spoke of the immense importance of chemical engineering, instancing synthetic rubber, RDX, penicillin and plutonium, Professor A. V. Hill discussed "The Responsibilities of Scientists in Modern Society" at the third session. "The other sciences lag many centuries behind medicine in the ethical approach of their practitioners to their job," he said. After quoting the Hippocratic Oath,

> "If standards of truthfulness, frankness and integrity are relaxed either for political motives or private ambition and gain; if fraud, dishonesty and self-deception are not denounced; if mistakes are not honestly acknowledged and corrected; if propaganda is accepted in place of fact; if the common prestige and goodwill of science are prostituted for base, sectional or selfish purposes; if secrecy or secretiveness is accepted as a normal condition of scientific work; if age, prestige of authority; if race or nationality, is allowed to hinder freedom of intercourse between scientists of honesty and goodwill; if there is widespread failure to recognize an unbreakable obligation that the benefits of scientific discovery must be regarded as a sacred trust for all mankind; then science itself may become impossible as a calling for free, honest and decent men."

"Scientists must take the initiative in this," commented Professor Hill, "otherwise we and civilization will perish together."

Professor J. D. Bernal considered that people broke away from planned tradition in the Renaissance and today we were afraid of the unplanned tradition of the Renaissance and Industrial Revolution. Planning without democracy was not effective planning; but "there must be no blind devotion to duty as in the Nazi State, which was much less efficient during World War II than was Britain."

Mr. Arthur Horner, President of the South Wales Miners and National Coal Production Officer of the National Union of Mine Workers, said that workers were still suspicious of science, but their interest had been aroused in scientific matters by the magnificent contribution of scientists to the defeat of aggression.

Professor P. M. S. Blackett, President of the Association of Scientific Workers, held that the veto clause in the procedure of the Security Council of U.N.O. was

vital to international control of atomic energy. Sanctions could not be brought against a great power and security lay only in their agreement not to fight. The atomic bomb could not be used for policing purposes. The complete elimination of atomic weapons as proposed in the Assembly of the United Nations was the only solution.

Dr. Julian Huxley seemed full of high spirits and enthusiasm since his recent appointment as Executive Secretary of the Provisional Commission for U.N.E.S.C.O. He was pleased, " because I am a scientist, which shows that the authorities consider science should play an important part in the organization." War, he considered, had shown how methods of natural science can often be applied to social problems. He hoped that the two great branches would one day be one.

He pointed out the great success of operational research to wartime problems and hoped for a strong representation of the applied and industrial sciences on his Commission, for " we will not be highbrow or academic. That is important. . . . It is clear that you do not get rapid progress until you have the different human groups that exist into a single world community with a single pool of knowledge, tradition and purpose. Science and the scientific way of thought is as yet the one human activity which is truly universal." If U.N.E.S.C.O. is to do any good it must start with big and bold ideas, " A levelling up—not down —of scientific activity in the less scientifically developed countries."

The British outlook on science today is truly international in its finest sense. The speakers from France, Poland and other countries and the remarks from those partaking in the discussion continued to mirror the very strong desire of all the main speakers for coordinated, yet free, scientific activity on an immense, world-wide scale for the benefit of all humanity.

A DETERMINATION OF THE PRINCIPLES OF ENTOMOLOGY OF SIGNIFICANCE IN GENERAL EDUCATION. I *

GEORGE J. BERGMAN

IN the literature dealing with science education, prominence is given to the understanding of principles as one of the major objectives in the study of science. This view was strongly emphasized, for example, by the National Society for the Study of Education in its *Thirty-first Yearbook* [1] wherein the following statement appears: "The first steps in the program of curriculum work in science in the public schools may be directed toward the determination of those major generalizations and associated scientific attitudes which together define the field. . . . Principles and generalizations of science are objectives. Learning experiences result from activities selected for their contribution to the enlargement of the meaning of these objectives."

Principles alone are not sufficient to permit students to grasp fully the significance and value of a science. The relationships of the science to daily living must be stressed, especially in a program of general education. Therefore it is essential that students acquire a complete understanding of the *social implications* of the principles of a science, so that they may interpret their environment and become adjusted to all its aspects.

This study indicates the importance and social implications of the principles of entomology, which is that subdivision of biology pertaining to insects.

* Based on a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Education of New York University, October, 1946.

PROBLEM STATED AND DEFINED

This study was undertaken because of the investigator's realization that man's health, comfort, and economic welfare are affected to a great extent by the activities of insects. Not only is man affected personally, but plants and domestic animals which are valuable to him are also harmed in many ways. However, the tremendous damage wrought by insects is counterbalanced by their production of substances which have considerable economic value.

Insects are often designated as "bugs", or creatures to be abhorred. They are usually regarded as interfering with man's physical comfort by biting, stinging, piercing, sucking, crawling, buzzing, and transmitting diseases. It was felt necessary to clarify the role of insects in their relations with other living things, so that appreciations of their work might be formed through an understanding of the social implications of entomology.

It was also realized that students who study biology for general education would have a valuable fund of knowledge if they were to acquire an understanding of the principles of entomology, instead of being burdened with minor anatomical details, as is often the case. Therefore this study was carried out with the purpose of developing a list of principles of entomology in the order of their relative significance for general education, based on the extent to which they meet the various criteria of general education.

The definitions of terms as used in this study are given as follows:

"Entomology" is that branch of zoology which deals with the study of insects.

A "principle" is taken to mean a verifiable, scientifically true, comprehensive generalization or fundamental statement for which the widest possible range is given, and which describes some fundamental structure or process, constant mode of behavior, or property relating to natural phenomena.

A "main principle" is one which encompasses many major principles, such as "Life exists in the form of living things."

A "major principle" is one which is fundamental, but which is not as inclusive as a main principle, such as "Food is necessary to the continued existence of all living things, in order to supply fuels (fats and carbohydrates) as sources of energy, materials (proteins) for growth and repair of tissues, and substances (minerals, vitamins, water) for regulating body processes."

A "minor principle" or "subprinciple" is a minor generalization or statement which is subordinate to a major or larger generalization or more fundamental statement, such as "The manner in which an organism feeds depends on its adaptations for obtaining food."

A "generalized fact" is a statement which is subordinate to a minor principle, and which is general in that it has reference to some feature which is common to a number of organisms, such as "Saliva is secreted by salivary glands."

A "specific fact" is a statement which has reference to a specific feature of a particular organism, such as "The mosquito *Anopheles quadrimaculatus* transmits malaria to man in the United States."

"General education" refers to that broad, integrated, nonvocational and nonspecialized part of a person's education which leads to personal growth and responsible citizenship by preparing him for satisfactory adjustment to the needs and problems of his environment, and for active participation in the many aspects of living.

SIGNIFICANCE OF THE STUDY

The significance of the study may readily be realized through an understanding of the importance of insects, and the importance of principles in science education.

The Importance of Insects

Insects constitute the largest group of animals, greatly outnumbering all others. Of the 916,000 described species of animals, nearly 700,000, or about 75 per cent

are insects. It has been estimated that between 2,000,000 and 10,000,000, species are yet to be described. About 6,000 new species are described each year.

How Insects Are Injurious

Nearly all the injuries caused by insects are the direct results of efforts to obtain food. Because of their adaptations and variety of habits, insects feed upon practically every existing kind of organic material. About 10,000 species are injurious to plants and animals. Some insects are major pests (about 500 in the United States), while others are less injurious.

Fernald and Shepard [2] state that insects damage 10 per cent of all kinds of crops in an average year, including field crops, forests and forest products, farm wood lots, domestic animals and their products, stored articles, shade trees and ornamental plants, household goods, and foods. Hyslop [3] has estimated that the annual damage by insects amounts to $1,601,527,000, including the total value of crops damaged plus the cost of control. The losses caused by human and animal diseases which are transmitted by insects have been figured at about 50 per cent of the total losses caused to all farm products. Table I, based on figures given by Hyslop, indicates the extent of some losses due to insects.

TABLE I

SOME VERY DESTRUCTIVE INSECTS, AND THE ANNUAL LOSS IN THE UNITED STATES RESULTING FROM THEIR ATTACKS AND INFESTATIONS

Insect	*Annual Loss*
Insects affecting stored cereals	$300,350,000
Cotton boll weevil	121,283,000
Forest insects	100,000,000
Housefly	66,450,000
Termites	40,000,000
Codling moth	31,000,000
Grasshoppers	25,701,000
Clothes moths	22,734,000
Hessian fly	13,018,000
Japanese beetle	3,490,000
Gypsy moth	2,147,000

In the course of their injuries to plants, insects chew or suck sap from leaves, buds, stems, bark, roots, and fruit, causing loss of vitality, stunted growth, deformation, wilting, and death. Eggs are laid within the plant tissues, and the young which hatch from them feed upon the tissues, causing a reduction in the quality and quantity of commercially valuable plants. Abnormal plant overgrowths or "galls" are formed on leaves, stems, buds, and roots by toxic substances which are introduced into the plant tissues by sucking insects. Insects also aid in the spread of plant diseases by injecting and disseminating pathogenic microorganisms, such as fungi, bacteria, viruses, and protozoa.

Insects injure and annoy man and domestic animals by stinging, biting, injecting poisonous venom and pathogenic microorganisms into the body, transporting disease organisms to food, the unbroken skin, or wounds, and by causing severe skin irritations and serious internal damage. Many of man's possessions, such as books, furniture, foundation timbers, telephone poles, stored grains and cereals, drugs, clothing, leather, tobacco, and others are depreciated in value or destroyed by insects. Domestic animals frequently become greatly weakened or die as a result of the attacks of larval and adult insects; growth and fattening are checked, milk and egg production become lessened, hides are rendered practically worthless, and working efficiency becomes reduced to a minimum.

How Insects Are Beneficial

In insects, metabolic activities yield products which are very much in demand by man. The salivary glands of the silkworm produce saliva which hardens to form threads of silk. Dorsal glands of a tiny female scale insect of India and Burma secrete "lac", used in making shellac. Another tropical scale insect yields a beautiful red dye called "cochineal", used in giving fast colors to silk and wool, and as an indicator in chemical analysis. Honey and beeswax are produced by the honeybee. Blowfly maggots secrete a substance called "allantoin", which can clean up deep-

seated wounds and bone infections. Galls, caused by insect secretions, yield permanent inks and valuable dyes, such as tannic acid. Cantharidin, a secretion of blister beetles, is used in animal breeding, in urogenital diseases, and as an external irritant. Bee venom has been used in treating hives, arthritis, and rheumatism. Finally, studies on the light-producing secretion of fireflies, called "luciferin", may aid in the synthesis of an artificial illuminant giving almost 100 per cent light with a minimum of heat.

Insects also pollinate flowers, destroy other insects which are injurious to man, maintain the fertility of soils, act as scavengers, and serve as food for insectivorous plants, fresh-water fishes, song and game birds, lizards, frogs, toads, small mammals, and man. The shapes and colors of insects are used as patterns and designs for jewelry and dresses. Scientific studies of insects have given us valuable information concerning instinctive and tropistic reactions, genetics, variation, and geographical distribution of species.

It can be seen, therefore, that insects present both good and bad aspects in their relationships with man. They have become structurally and functionally adapted to a great variety of environmental situations, and will undoubtedly continue to wreak havoc by perpetuating their habits of adaptation for thousands of years to come.

The Importance of Principles

Specific facts may be understood when placed in isolation, but fuller comprehension is more readily achieved when there is an understanding of the principles which are derived from the facts.

Previous studies reveal that factual learnings are rapidly forgotten, while principles, once understood, are not only remembered but are understood better after a lapse of time. Tyler [4] reports that eighty-two students who had studied elementary zoology at Ohio State University during the year 1931–1932, were given retention tests fifteen months after completion of the course. It was found that specific facts were most quickly forgotten, but information having more general application was more permanently retained. In another study, Frutchey [5] gave five pre-tests measuring certain knowledge, skills, and abilities to students studying chemistry in three Ohio high schools. Gains were measured by a test given nine months after the pre-tests, and retention was measured one year after completion of the course. It was found that, in the application of principles, both boys and girls retained the same percentages of their progress made in the course. Thus principles are retained longer than facts, and are therefore more valuable in an educational program.

In order that a student may develop a clear understanding of any science subject, it is essential that he comprehend the major generalizations of the subject. When many related statements of fact are brought together into a comprehensive, encompassing principle, there results great economy of thought. As new facts arise through interpretation of new situations, they may be adjusted to the principle already formed, or combined to form a new generalization or principle. A principle that is invariable and true in every instance, as observed by experimentation, measurement, and repetition, is frequently designated as a law, and may be used in the prediction of future occurrences.

A principle is therefore a statement which may prove to be of considerable value in teaching and learning because of its basic importance for more complete understanding of subject matter and its implications.

RELATED STUDIES

A searching analysis of the literature dealing with principles and with general education has revealed no previous study in which the principles of entomology were

carefully determined. There are many textbooks of general entomology, but none indicates which statements are principles and which are detailed, subordinate facts. In many cases, principles are regarded as being synonymous with the "essentials" or "fundamentals" of the subject.

Principles of the broad subject of biology have been determined by previous investigators in science education. In 1927, Menzies [6] analyzed 10 college textbooks of biology to determine the percentage of word space devoted to generalizations and their application to practical life situations. In no case was less than 78 per cent of the word space given to generalizations, and no more than 9.3 per cent was devoted to the application of biological laws to life situations.

In 1932, Downing [7] published a list of 28 principles of biology that function most frequently in the solution of problems of everyday life, based on four separate studies of biological principles appearing in a weekly magazine, in popular scientific books, and in government bulletins. Bentley [8] used Downing's list as a basis for his study of biological principles in 5 representative newspapers, and found that all but 5 principles appeared in them.

In 1936, Moyer [9] checking the daily activities of a radom sample of the general population, found that biological principles relating to food, common life processes, and environmental relationships ranked highest in importance. In the same year Olds [10] determined a list of 98 major and minor biological principles considered to be suitable as ultimate goals of instruction in secondary school biology.

In 1941, Winokur [11] constructed a biological science unit for orientation in natural science, after obtaining biological principles and generalized facts from four general biology textbooks, two orientation textbooks, and two popular biology books. Cretzinger [12] analyzed principles or generalities in 54 textbooks of high school biology, tracing the changes in the concepts of anatomy, health, evolution, taxonomy, origin of life, and cells.

In 1944, Martin [13] listed the 100 principles of the biological sciences which he found ranked highest in importance for general education. A similar study was made by Wise [14], who determined a list of 246 principles of physical science which are most important for general education, together with 3,163 applications which were assigned to the principles by four college teachers of science.

The latter studies by Martin in biology and by Wise in physical science have direct reference to general education. The present investigation, dealing with principles of entomology, is another study of this type.

PROCEDURE IN COLLECTING AND ORGANIZING

Determination of the Principles of Entomology

(1) *Analysis of Books, Pamphlets, Bulletins, and Research Articles.*

In order to learn which entomological textbooks and reference books are used in teaching the fundamentals of entomology, a letter was sent to the head of the department of entomology in each of 10 colleges and universities recognized for their entomology courses. Each letter included a check-list of 10 well-known entomological textbooks. Nine replies were received with the recommended books checked, together with separate lists of other entomological books in use at the institutions. A total of 10 general entomological textbooks and 30 reference books dealing with specific aspects of entomology was thus obtained.

Analysis of the general textbooks showed that the topics concerning insects fell into forty-one categories, such as "place in the animal kingdom", "external structure", "reproduction", "effect of physical environment", and "natural enemies." Each generalized statement which conformed to a particular category was

written on an index card labelled with that category. Also analyzed were 7 popular entomological books, and a total of 140 of the following: research bulletins of agricultural experiment stations, articles in journals of economic entomology and agricultural research, articles in professional biological periodicals, agricultural bulletins published by foreign countries, publications of the Smithsonian Institution, State Departments of Agriculture, State Boards of Health, the American Association for the Advancement of Science, the United States Department of Agriculture, and other miscellaneous publications.

When the analyses had been completed, the statements on each index card were combined, wherever possible, into one or more comprehensive generalizations which conformed to the definition of a principle used in this study. These included 41 major and 5 minor principles of entomology embracing 35 topics or categories. Principles for the remaining six categories were not immediately included because of the variety of generalized statements falling under each category.

(2) *Principles of Entomology Checked by a Jury.*

The 46 principles thus determined were mimeographed and sent for critical analysis to 15 outstanding entomologists in the United States, among whom were heads of departments of entomology, professors of entomology other than heads of departments, and entomologists employed by the United States Department of Agriculture. The characteristics of an entomological principle were described in an accompanying explanatory letter. Comments and criticisms noted by the 11 jury members who returned completed questionnaires were given careful consideration by the investigator. Each principle was modified in some manner to conform to the suggestions made. Two principles were incorporated into related statements, leaving 44 principles. The entomologists also proposed that a principle be drawn up for each of the following 8 categories which had been omitted from the list sent to them: "abundance", "distribution", "destructiveness", "usefulness", "control by man", "evolution", "parasites and predators", and "taxes." This was done after careful examination of all sources. A total of 52 entomological principles was thus determined.

(3) *Principles of Entomology Checked Against Principles of Biology.*

In order to determine whether the entomological principles were actually based upon, related to, or subordinate to the broad principles of biology, a comparison was made of the list of principles of entomology and a list of principles of biology which was drawn up in the manner to be described.

(a) *Assembling Studies of Biological Principles*

A survey was made of previous research studies in which principles of biology were determined and listed. Three such studies were found:

Martin's Study

In 1944, Martin [13] determined the principles of the biological sciences which are of importance for general education. A list of important biological generalizations was obtained by analysis of 3 biology textbooks used in junior colleges, 3 textbooks of high school biology, a survey series of biological science for the general reader, and reports of 5 research studies. Three science educators checked the statements against 2 criteria of a principle, and 3 biologists refined the statements. The resulting 300 major and 236 minor principles were then organized into a "master" list. Martin then analyzed selected magazines and newspapers, and found 2,573 statements which applied to this list. Five additional judges found 102 major and 26 minor principles to be ideally suited for general education. Based on the ranks attained in the evaluations, the 100 major

principles ranking highest for purposes of general education were listed in order of their decreasing value.

Careful analysis of Martin's list revealed that many of his "major" principles were minor principles, according to definitions used in the present study. His list was then broken down into 66 major and 34 minor principles falling into 33 categories, such as "the cell", "life processes", "heredity", "photosynthesis", and "transmission of disease." The most generalized principles were considered to be major principles in the present study, although it is realized that there may not be more than a dozen main principles of biology under which they may fall.

Downing's List of Principles

In 1932, Downing [7] pooled the results of studies by 4 men who had investigated principles of biology appearing in a weekly magazine, in scientific books for the layman, and in government bulletins. The published compilation includes 9 major principles arranged in descending order of importance, together with 19 subordinate principles, all of which were said to function most frequently in solving the problems of daily life. The 9 major principles fall into 9 categories, each of which corresponds to an identical category among the 33 obtained from Martin's list of principles.

Winokur's Study

In 1941, Winokur [11] constructed a biological science unit for orientation in natural science by analyzing 4 textbooks of general college biology, 2 books for orientation courses in science, and 2 biology books for the layman. All the generalized principles and generalized facts were recorded, with their relative importance indicated by the number of lines devoted to each. These were used as guides in developing an orientation outline which would lead to broad understandings of biological material.

By analyzing Winokur's list of principles and generalized facts, the investigator found that there were in his unit 5 main principles, 24 major principles, 21 minor principles, and 69 generalized facts constituting 21 categories. Two important categories of principles appear in Winokur's list, but are not present in Martin's and Downing's lists, namely "variation in structure" and "man and his use of biological knowledge." These were included in the final determination of biological principles made in this study.

By consulting all 3 lists of principles, a single, all-inclusive, comprehensive, major principle was determined for each of the 35 categories. In addition, 10 minor principles were drawn up, making a total of 45 principles of biology altogether.

(b) *Modifying the Biological Principles So As to Be Fully Inclusive*

A one-page questionnaire was sent to each of 15 outstanding chairmen of high school departments of biology, asking him or her to judge whether 7 listed textbooks of biology (3 high school and 4 college texts) were sufficiently representative for use in checking the list of biological principles. Returns were received from 12 chairmen who agreed that one of the high school textbooks was not acceptable. Two additional high school texts were recommended very highly, so that altogether 4 high school and 4 college textbooks of biology were used for the purpose stated.

Each principle of biology in the determined list was checked against the statement or wording of the principle of the same category in each of the 8 books. Those wordings which were considered to contribute to the accuracy and comprehensibility of the principles were used to revise, modify, and clarify them where necessary.

(c) *Comparison of Entomological and Biological Principles*

Each of the 52 principles of entomology was matched against the resulting 45 principles of biology. It was found that 14

principles of entomology had no corresponding biological principles. The 8 textbooks of biology were reanalyzed, with the result that 12 matching minor biological principles were found; the remaining 2 minor principles of entomology were seen to be based upon a *major* principle of biology. No corresponding principles of entomology could be found for 9 of the biological principles.

For the sake of brevity, the matched principles of biology and entomology are given below in an abbreviated form. Instead of the entire principle, the category or subject of each principle is given, so that the relationships may be readily perceived. The principles of entomology are listed in the order of their relative significance in general education, from most significant to least significant, as finally determined in this study. The complete wordings of the principles of biology and entomology will be given in a similarly matched list, to appear in Part II of this article in a forthcoming issue.

In the list below, a "B" indicates a principle of biology, an "E" refers to a principle of entomology, while an asterisk (*) indicates a minor principle. Those not preceded by an asterisk are major principles. The entomological principles are numbered from 1 through 52 in order to indicate their relative significance. Each principle of entomology is given immediately below its corresponding principle of biology.

B. Transmission of disease.
1 E. General destructiveness.

B. Interdependence of living things.
2 E. Usefulness.

B. Transmission of disease.
3 E. Harm to man and domestic animals.

*B. Control by natural enemies.
4 E. Control by man.

B. Protective adaptations.
5 E. Protective adaptations.

B. Migration and hibernation.
6 E. Migration.

*B. Variations in germ cells.
7 E. Control by resistant varieties of plants.

*B. Control by natural enemies.
8 E. Biological control (excluding man).

B. Hereditary factors.
9 E. Actions of genes.

B. Variation in structure.
10 E. Position in the animal kingdom.

B. Balance of nature.
11 E. Abundance.

B. Associations of organisms.
12 E. Social life.

B. Optimum environmental conditions.
13 E. Effect of temperature.

B. Descent through modification.
14 E. Evolution.

*B. Change in structure and form.
15 E. Metamorphosis.

*B. Effect of a parasite.
16 *E. Parasites and predators.

B. Distribution.
17 E. Distribution.

B. Dependence on soil.
18 E. Dependence on soil.

B. Division of labor.
19 E. Segmentation and parts of body.

B. Food requirements.
*B. Adaptations for obtaining food.
20 E. Sucking mouth parts.
21 E. Chewing mouth parts.

B. Reproduction.
22 E. Reproduction.

B. Balance of nature.
23 E. Environmental factors.

B. Maintenance of body form.
24 E. Exoskeleton.

B. Optimum environmental conditions.
25 E. Life cycle.
26 E. Diapause.

*B. Symbiosis.
27 *E. Symbiosis.

*B. Competitive reproduction for survival.
28 *E. Variations in reproduction.

*B. Protection for initial stages of development.
29 *E. Protection for eggs.

B. Metabolism.
30 E. Metabolism.

*B. Similarity of organisms within a species.
31 *E. Individuals of a particular species.

*B. Growth and repair.
32 E. Molting.

*B. Response to stimuli.
33 E. Response to stimuli.

B. Respiration.
34 E. Respiration.

*B. Appendages.
35 E. Antennae.

B. Glandular secretions.
36 E. Glands.

B. Regeneration.
37 E. Regeneration.

B. Food requirements.
*B. Storage of food.
38 E. Fat body.

*B. Sense organs.
39 E. Sense organs.

*B. Organs of vision.
40 E. Eyes.

*B. Inherited reactions of species.
41 *E. Taxes.

B. Endocrine glands.
42 E. Corpora allata.

*B. Appendages.
43 E. Wings.
44 E. Legs.

B. Food requirements.
*B. Necessity of water.
45 E. Water requirements.

*B. Increasing the volume of air.
46 *E. Air sacs.

B. Nervous system.
47 E. Nervous system.

B. Digestion.
48 E. Digestion.

B. Circulation.
49 E. Circulation.

B. Excretion.
50 E. Excretion.

B. Contractility of protoplasm.
51 E. Muscles.

B. The cell.
52 E. Cells.

It was found that a total of 52 (45 major and 7 minor) principles of entomology are subordinate to, are related to, or correspond to a total of 45 (27 major and 18 minor) principles of biology. Upon further analysis, the following relationships are evident:

(a) Thirty major principles of entomology are related to 23 major principles of biology.

(b) Fifteen major principles of entomology are related to 15 minor principles of biology.

(c) Seven minor principles of entomology are related to 7 minor principles of biology.

It follows from the above statements that a major principle of entomology need not necessarily be related to, or based upon, a major principle of biology. Whereas a principle of entomology may be considered to be of major importance because of its fundamental value, it may be based upon a subordinate or minor principle of biology. This is possible because entomology is a subdivision of the comprehensive subject called biology.

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(To be concluded in April issue.)

ABSTRACTS

CALDWELL, OTIS W. "Of What Does Good Biology Teaching Consist?" *The American Biology Teacher* 9:27–42. November, 1946.

This was the Banquet Address at the Annual Convention of the National Association of Biology Teachers at St. Louis, March 30, 1946. In this address, Dr. Caldwell emphasized the one enduring quality of each one of the three great teachers of biology: the great teacher of research, Agassiz; the great laboratory teacher, James G. Needham; and the great lecturer, John M. Coulter.

COMPTON, ARTHUR H. "Science and the Supernatural." *The Scientific Monthly* 63:441–446. December, 1946.

"Those whose thinking is disciplined by science, like all others, need a basis for the good life, for aspiration, for courage to do good deeds. They need a faith to live by. The hope of the world lies in those who have such a faith and who use the methods of science to make their vision become real. Such visions and hope and faith are not a part of science.

"Physics, chemistry, and biology are not concerned with them. They are known by an individual only as he himself experiences them. Though stimulated by the outside world, they are not a part of it. They are beyond the nature that science knows. Of such is the true 'supernatural' that gives meaning to life. This 'supernatural' is as real as the natural world of science and is consistent with the most rigorous application of the scientific method. . . .

"I take it that religion is concerned with the worship of God. 'God', however, is a word with many meanings. I shall consider three meanings that are of special religious significance: God as the ruler of the universe; God as a hero to be admired and emulated; and God as the spirit of the highest good which serves as the guiding principle of one's life. . . .

"Science is growing. Yet a world that has science needs as never before the inspiration that religion has to offer."

GOOD, CARTER V. "Research Methods Bibliography" *The Phi Delta Kappan* 28:210–215. January, 1947.

This is the author's seventeenth annual bibliography on the methodology of research. Articles and books are listed under one of the four following classifications: (1) Problems, Issues, Trends, and Critiques, (2) Library Guides, Bibliographies, and Summaries, (3) Collecting, Analyzing, Interpreting, and Reporting Data, and (4) Organization, Supervision, Implementation, and Support of Graduate and Research Programs.

EADS, LAURA K., AND BRISTOW, WILLIAM H. "The Education of Superior Children." Board of Education of the City of New York. *Curriculum Division Bulletin No. 3.* 39 p.

This bulletin raises problems and issues in-

volved in the education of superior children whether in special classes or not, and seeks to bring to bear pertinent research data on their solution. Part One deals with the identification of superior children: procedures, intelligence test results, terminology, bibliography of reference materials, and bibliography of tests. Part Two discusses characteristics and educational needs of superior children: home background, physical factors, personal-social factors, intellectual factors, related abilities, teaching programs, and bibliography of reference materials.

A REPORT OF THE HAWAII COMMITTEE ON EDUCATION IN POSTWAR RECONSTRUCTION. "*Postwar Needs of Education in Hawaii.*" 61 p. May, 1945.

Major features of this well-worked out report include: (1) Education and American Democracy, (2) The Significance of Hawaii's Program of Public Education, (3) An Overview of Postwar Educational Needs, (4) Suggestions for the Implementation of an Adequate Public School Program, (5) Curriculum Development in Hawaii's Schools, (6) The Selection and Preparation of Teachers, and (7) Higher Public Education.

ANONYMOUS. "Heavenly Fireworks Flash." *Science News Letter* 50:243. October 19, 1946.

The meteor shower of October 9 was the greatest and most brilliant in this century. Despite the light of the full moon, they were readily observable from all parts of the United States not obscured by clouds. Some are believed to have been bright enough to have cast shadows had there been no moonlight. In one hour more meteors were seen than in a normal lifetime. Some observers counted as high as 4,000 in an hour. The meteors were observed by radar, the first time this has been done.

SYMPOSIUM. "Our Land Resources." *Building America* 11:No. 5, 131–159. 1946.

This is an excellent article on America's greatest resource that has been so carelessly and heedlessly wasted. We are just now beginning to realize that robbed soils rob us. Land and minerals must be conserved with an all-out conservation program if much is to be saved from our past wasteful squandering.

CLARK, BLAKE. "D-D Saves Crops from Foes." *Science News Letter* 50:234–236. October 12, 1946.

New soil fumigants have an excellent chance of becoming the greatest boon to agriculture since the development of fertilizer. The proper use of the new chemicals will bring increased crop yields all over the world—reclaiming many crop lands and permitting the growing of the same crop on the same soil year after year.

D-D is especially effective against the destructive nematode infection. Nematodes are known as wire worms, round worms, eel worms, and attack the roots of a variety of plants—over 1,500 species in all—pineapple, tomatoes, potatoes, orange, lemon, grapefruit, tobacco, sugar beets, rice, tea, rubber, etc. Treatment of the soil with D-D has given astounding results. It has saved the pineapple industry of Hawaii from what looked like total destruction. Pineapple fields that had been yielding 12 to 30 tons an acre now average 40 tons (an increased cash yield of $250 an acre); tomato plants that yielded only 5 or 6 prune sized fruit in unfumigated areas averaged a bushel in fumigated areas; sweet potato yields increased from 816 pounds to 13,860 pounds per acre; lettuce yields 8 times; sugar beets from 3.71 to 17.7 tons per acre. Cost of D-D is about $40 per acre and may be obtained from local seed stores. The supply would seem to be unlimited.

SCIENCE SERVICE STAFF. "Science Review for 1946." *Science News Letter* 50:380–396. December 21, 1946.

This is the record of the progress of science during the first complete postwar period. It is a record of great accomplishment. It is too detailed to be presented here, but the problem of the control of the atom bomb ranks at the top of the list.

FRANK, R. W. "The Use of the Field Trip in Teaching a Phase of the Steel Industry at the Senior High Level." *The Journal of Geography* 45:322–326. November, 1946.

The author discusses the need for field trips, the pre-preparation for, the observations to be made, and the follow-up after the trip. The unit is good for geography or chemistry.

MEISTER, MORRIS. "The Notebook Problem." *The Science Classroom* 35:1. March, 1946.

Notebooks are valuable because they: (1) call for pupil effort and activity, (2) record a pupils' work, (3) help to measure results, (4) give continuity to the work of the term, (5) offer source material for review, and (6) offer stimulating projects for pupils.

SWEZEY, KENNETH M. "Chemistry Answers the Fire Alarm." *Popular Science* 149:202–205. December, 1946.

A series of experiments suitable for a chemistry or general science class are described in this illustrated article.

JOSEPH, ALEXANDER. "Demonstrations and Experiments." *The Science Classroom* 21:4. December, 1946.

The author describes three experiments: (1) heating effect of electricity, (2) photographic printing in daylight in a classroom, and (3) persistence of vision.

WRIGHT, ALFRED J. "Recent Changes in the Concentration of Manufacturing." *Annals of the Association of American Geography* 35: 144–166. December, 1945.

In 1940, 26 per cent of American wage earners were engaged in manufacturing, 23 per cent in commerce and trade, and 17 per cent in agriculture. In no other country has so much factory production been dependent upon so few wage earners. Six per cent of the world's population consumes 30 per cent of the world's raw industrial materials.

Since 1919 there has been a decline in the eastern or New England States. The Middle Atlantic states now lead in manufacturing. During the war the East North Central states (Ohio, Indiana, Michigan, Wisconsin, and Illinois) received the greater proportion of industrial facilities financed by the government. Increase in capacity among the states was in this order: Ohio, Pennsylvania, Michigan, Illinois, New York, California, Texas, and Indiana. These same states, although not just in the same order, led in war supply contracts.

The relative standing of states in manufacturing in 1939 (proportion of national total) was as follows: New York, Pennsylvania, Illinois, Ohio, Michigan, New Jersey, Massachusetts, California, Indiana, Connecticut, Wisconsin, Missouri, North Carolina, Maryland, and Rhode Island.

BOOK REVIEWS

EPSTEIN, SAMUEL, AND WILLIAMS, BERYL. *Miracles from Microbes, the Road to Streptomycin.* New Brunswick, New Jersey: Rutgers University Press, 1946. 155 p. $2.00.

The writers of this book do not claim to be part of the research forces that have produced the most spectacular discoveries in medical biology of the recent decades. The authors are writers rather than researchers, and in presenting this book they have achieved results surpassing the writings of most research scientists. They tell the essentials of their story giving place to each outstanding worker all the way from Pasteur to Wassman and Schatz, from vaccination against anthrax and rabies to the expected achievements of streptomycin. The story is factual, graphic, and humanitarian. It condenses into one small volume an engaging cumulative account which is most timely for good reading and a measure of guidance for people who read for gain for themselves and for the society to which they belong.

The story of bacteriology did not begin with the work of Pasteur and Koch. Earlier workers had discovered a good deal about bacteria. But Pasteur, Koch, and others during the last quarter of the nineteenth century developed techniques, made giant strides in their studies of specific diseases, and really laid the secure foundations of modern bacteriology. Even Pasteur and Koch would have been astonished by the recent achievement of the chemistry of bacteria and the chemistry of fungi. Indeed, modern chemistry has turned a brilliant searchlight upon many health problems which once were supposed to be entirely within the domains of bacteriology and plant pathology. Problems regarding health, like other problems in science are now finding solution through the combined focus upon them from several branches of science. Modern medicine provides some of our best illustrations of the values of team work by research men.

This book with the subtitle of "The Road to Streptomycin" after extolling the many virtues of penicillin, ends with glowing hopes for achievements of streptomycin. Some specific achievements have been proved, more are still in the experimental stage. If it proves that streptomycin is efficient against human tuberculosis the authors' glamorous account will have been justified.

The conspicuously absent index will annoy most readers of the book.

—O. W. C.

HEALY, RAYMOND J., AND MCCOMAS, J. FRANCIS (EDITORS). *Adventures in Time and Space.* New York: Random House, 1946. 997 p. $2.95.

The reader of science-fiction will want to add this anthology of thirty-four such stories to his collection. In them the caution of the scientist gives way to the unfettered imagination of the writer. To the authors of these stories, such earth-shaking devices as the atom bomb, rockets, robots, and time and space machines were everyday occurrences long before the Nazi V-2 or our own Oak Ridge. These stories are an exciting and sometimes frightening extension of the test-tube of today into the superman's world of tomorrow.

This excellent collection included stories by such outstanding practitioners of an unusual art as Robert A. Heinlein, Anthony Boucher, A. E. Van Vogt, Willy Ley, Lewis Padgett, S. Fowler Wright and others. Many of them appeared in such magazines as *Astounding Stories, Amazing Stories,* and *Planet Stories.*

—R. V. M.

ABBOT, C. G. *The Earth and the Stars.* New York: D. Van Nostrand and Company, Inc., 1946. 288 p. $3.75.

This is a book for "those who wish to acquire by easy reading a general survey of the

universe they live in." About one-third of the book tells the story of the stars. Then comes the solar system, including our earth and the moon. Of special interest are the chapters dealing with the possible use of the sun's heat for industrial heating, the account of the Abbot solar cooker, and related work. Interesting reading will also be found under the calendar, star places, navigation, and astronomers. There are 28 full page plates and 65 line cuts illustrating the book.

—W. G. W.

RIDDELL, JAMES. *In the Forests of the Night.* New York: A. S. Barnes & Co., 1946. 228 p. $3.00.

Two Englishmen, James Riddell and Kenneth Gandar Dower set out to Africa to take close-up photographs of African animals. They had twenty Leica cameras and on the whole apparently a well-fitted out expedition. Most of the camera work was performed at night using flash bulbs and black cotton trip wires. Among the photographs there are some, notably those of the bongo and the giant forest hog, that are probably unique in that they are the first satisfactory pictures that have ever been taken of these animals at liberty and in their natural surroundings.

The two boys realized that most pictures now available of African animals show them hurrying along after they have been disturbed or frightened by some native so that they would come out in the open and photographs could be made of them. As a result they were not natural, close-up photographs which the authors planned to secure.

The gorilla has never been very successfully photographed in his natural habitat and this was one part of their plan that they failed to accomplish but had their expedition not been cut short by the war, and the two men called to service it is possible that if they had two weeks longer they would have accomplished their task.

The book is interestingly written throughout. The Watusi tribe and the pygmies were of interest to the young explorers. When the pygmies first appeared among them one of the black natives assisting the two English boys was so amused upon seeing a pygmy for the first time that he laughed and laughed so disconcertedly that he had to be sent off to sit in the car alone. The pygmies are given permission to kill game where others are not permitted to do so. Their minds because of bad habits, drinking of "banana beer", and for other reasons begin to deteriorate after ten years of age. But it was the pygmies whom Gandar and Riddell had engaged to help them in photographing a gorilla—had they only been able to remain in Africa a few weeks longer.

Not only are the pictures of animals of Africa the very best, but scenery of the plant life and jungle of the Belgian Congo is quite different and superior to those commonly seen. There are 227 photographs in the book.

Now comes the sad part of the story for after the two young men left Africa and became "a part of the war" they never met but one more time and that was at Jerusalem. Later Gandar was killed, and the task of telling the story of their safari fell to Riddell.

This is a rare book on Africa and will appeal to millions of readers all over the world. Youth and grown-ups alike would appreciate the book as a gift.

In the Forests of the Night comes in an attractive blue-green and yellow jacket. It has been said of the book "it is no ordinary travel book. In it there is interest for the expert in natural history, for the amateur student of zoology, for the animal lover, for the camera fan, for the reader who loves a story that is told with humor and understanding."

—F. M. D.

STEWART, GEORGE R. *Man: An Autobiography.* New York: Random House, 1946. 310 p. $2.75.

Names on the Land was written also by George R. Stewart and, in writing "Man" he traces the story of man through the ages simply as history, anthropology and human drama. He traces the struggle of man as a foraging animal just out of the trees. Physical changes came about such as the development of the foot, loss of hair, but the most important was the change in the shape of the head. The snout kept shrinking back; the teeth, jaw, and jaw-muscles grew smaller. At the same time, the brain grew larger and more skillful. Just when did I, Man, first begin to be? He thinks the Pekin man had all the beginnings of the way of life which the author considers human. He made and used tools; he used fire, he apparently cooked his meat; he probably had language. He concludes that with the Pekin man, Man was born. Of five necessities, he had four and possibly five—tools, speech, fire, cookery, and clothing. He doubts whether anything that can really be called man was ever without them. Fire made it possible to cook the tough meat of the wild animal into something which weak teeth and jaws could economically chew and man then became more of a meat-eater. This helped to civilize man; he needed to spend less time eating and lying around stupidly afterwards. That left more time for thought and for play. To cook and have the fire in one place, as it could not be moved easily, man had a strong reason to settle down at a more or less permanent habitation. Cookery was a natural breeder of decorum, and enforced its rules of etiquette. Now the men hunted wild game while the women and children foraged for other things such as nuts and grass seed to eat. The author thinks man tied fur-skins about him for protection and that with clothing came modesty rather than the other way around as in the case

of Adam and Eve—where modesty produced need for clothing. In achieving the five essentials: tools, speech, fire, cookery and clothing, man's brain developed, and his hand became more clever. He now stored up a tradition of knowledge which one generation passed on to the next.

The author states that change may have been so slow in the development of man, that the smallest unit worth considering is an era rather than a year or a century. The mortar, the spear, the bow and arrow, were marvelous achievements and were stepping stones to further progress. The domestication of animals and the growing of grain crops such as wheat and barley and the use of power-animals made man more secure and settled in nature. Change breeds change and village after village arose, finally some declining while others grew into large cities—the era of city growth. Classes began to develop and in some ways of thinking everyone was actually a slave to the god-king. But in practice things did not work out that way, and a small upper class usually kept some freedom of choice. At the same time there remained a slight distinction between the peasant who was bound to the soil and the actual slave. The author thinks that most of the people became slaves or peasants, at best; they lived poorly even in good years, and starved wholesale in famines. But a few people lived well all the time, and developed what is called civilization. The practical choice may have been whether most people became slaves, or all people became slaves. What actually happened may have been the less of the two evils. The second great social discovery of this age (if it can be called "social" and not "anti-social") was the perfection of the technique of conquest. They learned that it was profitable in waging war to conquer but not kill all the people. This was a step in advance of killing off all the people and deriving little benefit from conquering. Nowhere in the world probably have people as yet got wholly out of their minds the first idea of this civilization—that some should be lords (or ends in themselves) and others should be slaves (or means to the end).

Writing evolved by easy stages over a long period of time but the invention of the alphabet came later, and as yet cannot be traced back beyond 1500 B.C. Writing was an excellent preserver and spreader of all kinds of knowledge and had a number of far reaching results. When Rome conquered barbarian Gaul, the conquered barbarians were more advanced in some ways than their conquerors, but their special achievements were lost; for example certain of the Gauls were much better seamen and navigators than the Romans, but the Romans killed most of those tribes and turned the rest of them into slaves and provincials—and perhaps put the discovery of America off for a thousand years.

In one instance the author surmizes that maybe it would have been just as well if he, Man had not come down out of the tree at all and as one reads the daily newspapers or listens to the radio there are times when we would like to hear better things about ourselves.

The author believes that civilization will continue and that no war will ever destroy it utterly. Continued progress at our recent pace is most unlikely and so civilization may become static or even retrogress.

This is a Scientific Book Club (nonfiction Book Club now) selection and is highly recommended to all laymen and for the biology book shelf.

The author was born in Pennsylvania and received his academic training at Princeton University and completed his post-graduate work at the University of California and Columbia University.

—F. M. D.

GILBERT, MABEL CRAWLEY, AND GILBERT, ROSS WINTHROP. *Origin of Species by Special Creation.* Oakland, California: Ross W. Gilbert, P.O. Box 88. Fruitvale Station, 1946. 29 p. $1.00.

This theory of the origin of species by special creation is based on the following considerations and assumptions: (1) The species originated independently, and are not related. There are no "common ancestors" among protozoic or metazoic species. (2) A species cannot by modified into another species by any process, natural or artificial. (3) All species originated in the ocean, (4) Ontogeny is a literal and accurate account of phylogeny, (5) Life and the living forms we know could not have originated and developed under the unguided operation of natural forces, (6) Adaptive characters, like the tools and implements of human culture, are the products of creative intelligence, and (7) Living organisms harmonize with their surroundings because they were designed to do so.

"Species originated at different times. The simpler forms are older, the more complex forms are younger. Bacteria, viruses, and enzymes are the oldest forms of living matter, dating, probably, from Archaen times. The human species is youngest, dating from the late glacial, or early post-glacial times." All biologists will agree that this is a revolutionary theory of organic evolution.

—C. L. D.

WILLIS, H. L. *The Origin of the Solar System.* Mount Vernon, Wash. Hollyhurst Publishing Company, 1946. 167 p. $2.50.

This is a new theory of the origin of the solar system, not quite as revolutionary as the origin of species by special creation referred to above. Yet many if not most or all astronomers are likely to be slow in acceptance, with a much greater likelihood of final rejection. The author goes to considerable length and often with seem-

ing logic to prove the correctness of his theory. Admittedly, astronomers are about to the place of rejecting all present theories of solar system origin, and only agreeing in the fact that there is a solar system. All present theories have many factors completely against their acceptance, so astronomers are almost in a position of not knowing exactly where they do stand in regard to beliefs as to the origin of the solar system. They are definitely less certain than they were a decade or so ago.

The author accepts a two star theory solar origin, but rejects the collision and tidal theories and the tenuous filament assumption of Jeans. The Lyttleton binary star theory is also rejected.

Willis assumes the formation of the planets took place in a relatively small area between the sun and a passing star at a point where the influence of gravity was practically neutral. One star had a greater velocity than the other. The planets were in the beginning much closer together—possible Pluto and Mercury were only a million miles apart. The four inner planets came from the sun—the outer planets came from the passing star. The author presents theories that he believes explain many things about the solar system not explained by other theories—e.g., the origin of meteors and comets, the small size of Mars, the even spacing of the inner planets and the uneven spacing of the outer planets, the large size of the outer planets, why primary statellites have circular orbits and secondary satellites have elliptical orbits, and so on.

—C. L. D.

WILSON, CHARLES MORROW. *Oil Across the World.* New York: Longmans, Green & Company, 1946. 318 p. $3.50.

Oil Across the World is the American saga of pipe-lines. Few writers surpass Mr. Wilson's ability to write effectively and entertainly on material that would be drab and unimaginative when written by the average writer. Witness his earlier *Cornbread and Creekwater, Trees and Test Tubes, New Crops for the New World,* and so on.

This story of American pipe lines is a remarkable one. They play a staggeringly large part in our economy and were vitally important in World War II. The author made a special and prolonged study of American pipelines.

Pipelines go back to at least 5,000 B.C. when the Chinese used water pipelines made of bamboo. Ancient Babylon had water pipelines made of clay as early as 4,000 B.C. Egypt had copper pipelines 5,000 years ago. Roman pipelines of 100 A.D. carried an estimated 332 million gallons of water daily. The first gas pipeline was that at Fredonia, New York, in 1821. The first successful oil pipeline was laid in Pennsylvania in 1865.

Today pipelines work above the Arctic Circle, in the steaming jungles of South America, the Pacific Islands, in Africa, Europe, Asia, and the Middle East. The laying of pipelines across the English Channel perplexed the Germans at one stage and made it possible to crush them at another. Rubber-jointed pipe, hastily laid across the fields of France, carried gas and oil for the armored spearheads of invasion.

Everyday in the United States about 210 million gallons of petroleum are grathered or transported in steel pipelines. The United States has 129,000 miles of trunk pipelines for oil; 245,000 miles for natural gas; and 17,000 miles for gasoline. In addition to these 391,000 miles, there are 225,000 miles of pipeline built directly from the oil wells and gas wells. Pipelines today carry or help carry about 45 percent of all the power and heat requirements of the United States. In 1945 United States pipelines carried 140 billion ton miles. The United States has at least three times as many miles of power-operated lines as all of the rest of the world combined.

The two most publicized American pipelines are the Big Inch and Little Inch—24 inches and 20 inches respectively. These two lines, before being discontinued in 1945, carried about 21 million gallons or 500,000 barrels every 24 hours. The Big Inch has a capacity of 300,000 barrels a day—required 360,000 tons of steel (228 tons of steel per mile) and cost about 76 million dollars. It has 26 main pumping stations, averaging 52 miles apart, each manned by 3 or more 1,500 horsepower electric motors driving centrifugel pumps that take in the crude at 30-pound pressure and discharge it from the station at around 725 pounds. The Little Inch is 1,475 miles of main line from Beaumont, Texas to Linden, New Jersey, plus about 170 miles of feeder lines in Texas, plus 100 miles of extensions in the Linden, New Jersey area.

Oil Across the World is an outstandingly fine book—a must for the chemistry or science book shelf. It is an excellent reference for the physical science survey class, geology class, for all science teachers, as well as laymen. When you have read the book, you lay it down with thought—this is an unusually fine science book—about the best I have ever read on oil.

—C. L. D.

SAMUELS, M. M. *Power Unleashed.* New York: Dorset House, Inc., 1946. 303 p. $3.50.

Power Unleashed is the story of electricity and power told in non-technical language. The author is an internationally known authority on the generation, transmission and distribution of electricity and electric power. He has the ability to write in easy, non-technical language that is stimulating and thought-provoking.

In the introduction Dr. William E. Mosher, Dean of the Maxwell Graduate School at Syracuse University says "There is perhaps no single invention which has contributed more to changing our mode of life, our standards of living and the character of our civilization than

the harnessing of the force called 'electricity' to the needs of man."

This is an excellent book for the high school physics and general science teacher and pupil. Probably no place else will they find a more comprehensive, easily understood treatise on electricity and electric power. Elementary science and geography teachers would also find this an excellent reference.

—C. M. P.

MONCRIEF, R. W. *The Chemical Senses.* New York: John Wiley & Sons, Inc., 1946. 424 p. $4.50.

The chemical senses of taste and smell play a very important part in the lives of men, animals, and insects. Evidence substantiates the belief that these senses are less keenly developed in men than in either animals or insects. In fact, the late well-known chemist Dr. Elwood Hendricks said that the sense of smell in man was the least developed and the most neglected of all his senses.

Dogs are credited with an unusually well developed sense of smell, but seemingly they are surpassed by a number of animals.

It is known that beasts reject poisonous plants, and birds reject poisonous berries. It is believed that the safety of the animals lies in their much keener sense of smell and taste. Pigmentation seems to be related to these senses. Animals lacking in pigmentation are much more subject to poisoning. In parts of Virginia, farmers will raise only black pigs as white pigs eat and are poisoned by roots of Lachantes tinctora which the black pigs leave alone. Black sheep avoid another poisonous plant readily eaten by white sheep.

Odors are related to reproduction, being especially important in insects and some animals. Odors have greatly influenced civilization, being associated with certain religious activities, in aesthetic enjoyment, in disease, in hygiene, in eating and drinking, in industry, and as warnings. Certain diseases emit quite typical odors—diabetes, smallpox, diphtheria, typhus, rheumatism, and so on. One can never forget the stock yard smell, the decayed cabbage odor of some paper mills, fertilizer plants, linoleum works, retting flax, and so on.

Smells may be pleasant, unpleasant, feeble, faint, strong, bland, pungent, mawkish, fruity, dank, arid, stuffy, sulphury, aromatic, ethereal, balsamic, acid, fragrant, ambrosial, burnt, repulsive, nauseating, distracting, alluring, seductive, soft, heavy, sharp, spicy, flowery, penetrative, resinous, foul, and so on. But there are only four tastes—sweet, bitter, sour, and salt.

This is probably the most complete treatise on the chemical senses that has ever been published. It is thoroughly documented with references to the research literature. It is most readable and quite interesting. A great many chemical formulas are introduced but these can be omitted by the lay reader without too much loss to him. It is excellent for the science teacher, especially the chemistry teacher.

The author discusses at some length the structure of the chemical sense organs, the theory of sensation, olfaction, gustation, the common chemical sense, chemical sensibility in lower animals, classification of odors, chemical constitution and odor, chemical constitution and taste, physical properties of odorous substances, theories of odors, perfumes and essences, flavors and foods. There is a good glossary, an extensive bibliography, and a helpful subject index.

—C. L. D.

BURNETT, R. WILL. *To Live in Health.* New York: Silver, Burdett Company, 1946. 332 p. $2.44.

This is a reprinting of a textbook first published in 1944. The book begins with an analysis of the whole health problem. It presents a picture of the national health and then analyzes the types of knowledges, attitudes, and insights necessary to combat the problems at hand. Facts basic to these knowledges, attitudes, and insights are then developed in graphic fashion.

The general appearance of the book is attractive, a good quality of paper is used; better than usual readable type; interesting modern clear-cut photographs and illustrations. One gets the feeling that the author had both the pupil and teacher in mind constantly as he wrote the text. The reviewer believes the content has been unusually well selected. It will serve either as about the finest textbook at the pre-college level to be found for courses in health or as an excellent supplementary reader in the high school biology course.

—C. M. P.

BAYLES, ERNEST E., AND BURNETT, R. WILL. *Biology for Better Living.* New York: Silver Burdett Company, 1946. 754 p. $3.50.

This is a reprint of a high school text first printed in 1941. Reviewed at that time, it was then considered one of the best high school biologies that had been written. Nothing has changed its high ranking since that time. Excellent literary style, well selected and unusually fine photographs, a fine quality of paper, appropriate content, and practical supplementary teaching and learning devices combine to make this a biology of outstanding merit.

—C. M. P.

VANCE, B. B., AND MILLER, D. F. *Biology for You.* Chicago: J. B. Lippincott Company, 1946. 731 p. $2.28.

Biology for You is a comprehensive, interesting, and practical textbook in high school biology organized around fifteen units presented in teachable sections. A helpful 24 page glossary and a variety of tests and activities make the book adaptable to the needs of students. It is profusely illustrated with black and white photographs. The chapter on insects is accom-

panied by a 6 page table of common insect pests and their control. This book deserves its title.

—G. O.

SMITH, VICTOR C., AND VANCE, B. B. *Science for Everyday Life.* Chicago: J. B. Lippincott Company, 1946. 731 p. $1.96.

Here is a basal general science text complete for a one-year course but adapted also for the 8th and 9th grades. The book contains six units divided into three chapters each and each of the chapters, eighteen in number, is divided into six daily lesson problems. A complete activity and testing program is included in the text itself. There are one hundred eight demonstrations and one hundred ninety experiments. Additional mastery tests and a teacher's handbook accompany the text. The selection of subject matter conforms with requirements of standard courses of study. The authors interpret science as a way of learning and living.

—G. O.

FORRESTER, J. D. *Principles of Field and Mining Geology.* New York: John Wiley & Sons, Inc., 1946. 647 p. $7.00.

This book is written to present an analysis of geological field techniques which will function as a working guide for the approach, pursuit, and solution of geological problems, particularly those of mining geologists. It is written for the field man who has acquired the elementary principles of geology and minerology.

Sections of the book are headed Recognition of Geologic Phenomena, General Field-Survey Practices and Procedures, Special Field Techniques of Mining Geology, and The Interpretation and Use of Field Data.

The book is well illustrated with charts, diagrams, maps, and photographs. It may be used with equal success as a textbook for teaching principles or as a field reference book.

—R. V. M.

SHERMAN, HENRY C. *Chemistry of Food and Nutrition.* New York: The Macmillan Company, 1946. 675 p. $3.75.

The purpose of this book is to present the principles of food chemistry and nutrition to college students. The closing chapter deals with the significance of current progress in foods and nutrition and the reference readings at the close of each chapter are comprehensive and suggestive.

—G. O.

MELDRUM, WILLIAM BUELL, AND DAGGETT, ALFRED FREDERICK. *A Textbook of Qualitative Analysis.* New York: American Book Company, 1946. 431 p. $3.50.

The authors are professors of chemistry at Haverford College and the University of New Hampshire, respectively. The two most important and generally applicable methods of qualitative analysis of inorganic materials are the *macro* and the *semimicro* methods. The former, the classical method, was developed over a century ago; the latter has been in common use for little more than a decade. The two methods involve different techniques but serve equally well as means of developing experimental skills and as a means of illustrating chemical principles. The main difference between them lies in the quantities of reagents and of material required for analysis. This book uses the semimicro method.

The first two hundred fifty pages or so is given over to an excellent theoretical treatment—one of the best to be found anywhere. Students using this book will not only know a lot of a real chemical theory but they will have had a lot of practice in developing experimental skills.

—C. M. P.

GREAVES, JOSEPH, AND GREAVES, ETHELYN O. *Elementary Bacteriology.* Philadelphia: W. G. Saunders Company, 1946. 613 p. $4.00.

This fifth edition has been written with the hope of furnishing a suitable text for courses in elementary bacteriology, yet it should prove helpful to nurses, home demonstration agents and home economics workers and even to the curious layman. Here we may read the appeal of bacteriology, the founding of the science of bacteriology, the conquest of diseases caused by bacteria as well as man's use of these microorganisms in the treatment of sewage, milk and milk products, in the arts and industries, together with the anti-toxins, vaccines, and viruses.

—G. O.

LUDER, W. F., AND ZUFFANTI, SAVERIO. *The Electronic Theory of Acids and Bases.* New York: John Wiley & Sons, Inc., 1946. 165 p. $3.00.

The historical background of the theory is discussed, as well as the details of its use, and its application to chemistry as a whole. The electronic theory of acids and bases was first proposed by G. N. Lewis in 1923. According to the Lewis theory, acidity and basicity have nothing to do with the presence of any one element or specific groups of elements. Nor is any particular substance to be considered an acid or base in an absolute sense. Acidity and basicity are relative terms indicating certain types of experimental behavior which may be exhibited by the vast majority of chemical compounds. Most of them may behave either as acids or bases depending upon conditions.

—C. M. P.

BABOR, JOSEPH H. *Basic College Chemistry.* New York: Thomas Y. Crowell Company, 1946. 701 p. $3.75.

The content of this textbook is based on the author's modification of the Luder Periodic Table. The sequence of topics is based on an orderly study of the elements as they appear in the new Periodic Table. After a discussion of

typical representative elements, the theories of solutions, chemical equilibrium, and ionization are introduced. The quantitative aspects of chemistry are stressed and the dimensional method of solving problems is consistently employed. The author is Associate Professor of Chemistry in the College of the City of New York.

—C. M. P.

CREHORE, ALBERT CUSHING. *Electrons, Atoms, Molecules.* Boston: The Christopher Publishing House, 1946. 133 p. $3.75.

It is said that Dr. Crehore has a grasp of his subject such as few men in the world can claim. He sets forth in this book his own striking and astounding theory of the atom. He presents an entirely new conception of the forms of atoms in their steady state which discounts the cloud-of-electrons atom now advocated by practically all physicists. Using his form of atoms which have no outside orbital electrons in their normal undisturbed steady state, he explains and correlates various physical phenomena.

The author is one of the most well informed nuclear physicists of this era. He is an inventor of note, selling many of his patents to railroads and telephone companies. He equipped the Pennsylvania Railroad with his "duplex-diplex" invention for sending through messages from Pittsburgh to Toledo while some thirty active way-stations used the line.

Also included in this book are two original geometrical theorems which are analogous to the Pythagorean theorm usually taught in high schools. —C. M. P.

HOLLIS, ERNEST V. *Toward Improving Ph.D. Programs.* Washington, D. C.: American Council on Education, 1945. 204 p. $2.50.

Present conditions tend to make the Ph.D. primarily a practitioner's degree in some particular profession, just as the M.D. has long been the general stamp of the medical practitioner. For research workers with advanced degrees the drift has been definitely toward private industry and publicly financed or endowed research organizations other than those that are primarily educational institutions. Holders of doctoral degrees in educational institutions are fundamentally teachers, either classroom teachers or trainers of graduate students. More than half the individuals with Ph.D. degrees in this country are teachers.

Employers of advanced degree holders and many of the recent candidates for degrees have become critical of the traditional requirements for degrees in the light of the actual duties that need to be performed after the degree has been granted.

The present study presents pertinent data concerning this issue and others related to it. The recommendations are not as clear and specific as the reader may wish but there is much information upon which the policy makers should be able to formulate recommendations of their own.

It should be read by deans of graduate schools, heads of departments, employers of university graduates, university faculty members directing graduate study, and by prospective candidates for doctoral degrees. —R. K. W.

ODELL, C. W. *An Introduction to Educational Statistics.* New York: Prentice-Hall, 1946. 269 p. $3.50.

The author has intended this volume as a text for a one-semester course in elementary educational statistics. Notable features are to be found in its conciseness and clarity.

Some teachers will find it difficult to cover as much material as this book provides in a beginning course. In some respects the arrangement is unusual. For example, the treatment of sampling and the fundamental assumptions involved are reserved until the last chapter. The author is aware of these points and has made suggestions for possible omissions and rearrangements in his preface.

Some of the technical terminology seems unnecessary in a beginning text. To meet this problem the index is arranged to serve the dual purpose of index and a very concise glossary.

In addition to its merits as a text, the book is to be recommended as a practical handbook and desk reference work for educationists frequently needing quick and convenient help with statistical problems.

—R. K. W.

NATHANSON, JEROME (EDITOR). *Science for Democracy.* New York: King's Crown Press, 1946. 170 p. $2.50.

The chief problem of our time is how to plan our economic and social life without sacrificing our freedom says the editor Nathanson. He further states that we can plan our national and international life intelligently and increase our freedom. The problem is how to do it. How can the disciplines of the scientific mind be infused into the democratic system? Physical science works as efficiently for the tyrant as for a free society.

The papers summarize the discussions on the third annual conference on *The Scientific Spirit and Democratic Faith* held in New York City in May, 1945. The papers are divided into four major divisions: (1) Science in the National Economy—includes: *Science and Human Welfare,* by Paul B. Sears; *The Scientific Spirit and Economic Dogmatism,* by Jerome Frank; and *The Gentlemen Talk of Science,* by Robert S. Lynd; (2) The Challenge of Science to Social Thinking—includes: *Freedom and Abundance,* by Kirtley F. Mather; *Psychiatry Comes of Age,* by John A. B. Millett; and *Challenge and Response,* by Geraldt Wendt; (3) *Does Private Industry Threaten Freedom of Scientific*

Research; and (4) *The Role of Science in the Determination of Democratic Policy.* The latter two parts are in the nature of a discussion—forum by twenty-six individuals of varying background—scientists and laymen (in so far as scientific training is concerned). Sharp differences of opinion were brought out in the discussions. Some believed private industry seriously threatened the freedom of scientific research; others disagreed with this view point vehemently. In general the conference seemed to feel that colleges and universities should not be caught up in the competitive aspects of the advance of science which are involved in patenting—they need to realize the very serious dangers of engaging in research for private firms.

In that part of the discussion having to do with the role of science in determination of democratic policy, there seems to be much confusion and as a whole an air of defeatism. The issues were not specifically defined—at least they were not concretely stated. One gains the definite impression that the leaders in the discussion did not clearly understand each other. Often they seemed lost in a fog of verbalism, from which they found it impossible to emerge. This should not be taken to mean that the discussion accomplished nothing. It probably did accomplish a good deal as its major purpose was one of formulation. At least the difficulties are now much more evident.

—C. L. D.

COMMITTEE ON PLANS. *A College Program in Action.* New York: Columbia University Press, 1946. 175 p. $2.00.

This is a review of working principles at Columbia College. It records the experience of twenty-five years of general education at Columbia College. Columbia College, which pioneered in general education began erecting the foundations of the present structure immediately after World War I. This book describes how such a program has been carried out, and how it has developed and changed. Columbia today is concerned with the next steps in improving and strengthening a curriculum tested by a quarter century of experience.

If the introduction to science, which has been alternative to departmental courses in the first two years is required (as is recommended) of all undergraduates, the three introductory courses will make up 44 of the 124 points now required for graduation, well over half of the freshman and sophomore programs. Brief descriptions and discussions of each of the general courses is included. —C. L. D.

OSIEK, PAUL H., AND RICHARDSON, ROBERT S. *Emergency Surgeon.* Philadelphia: Dorrance and Company, 1946. 291 p. $2.50.

Although *Emergency Surgeon* has been written in the form of an autobiography, the aim is much broader than the presentation of certain incidents in one doctor's life. A more important objective is a discussion of the many great problems that both medicine and society must recognize and solve. Dr. Osiek, surgeon at the Emergency Hospital at Pasadena, California, writes interesting of many behind-the-scenes accounts that a surgeon in a public hospital has to face. Few surgeons have had to face a more difficult beginning than Dr. Osiek. He first began practice at the very bottom of the depression and on more than one occasion almost decided to give up.

Emergency Surgeon will be enjoyed by the general reader. No attempt is made to glamorize the work of a surgeon nor on the other hand are the darker aspects unduly portrayed. Dr. Osiek feels that there is a definite place for religion in the practice of medicine. At one time only—during the seconds preceding an operation—he gives expression to his faith in the form of a brief prayer. He states that the desire to live and a patient's sincere belief he will recover is very important in ultimate recovery. The one great dread of all surgeons—never mentioned to the patient—is that an embolism may develop—a blood clot that may cause almost sudden death—even when the patient may be seemingly completely cured and well enough to go home.

—C. M. P.

LEE, JENNETTE. *This Magic Body.* New York: The Viking Press, 1946. 174 p. $3.00.

This Magic Body is a record of the author's search for a technique to restore bodies to their natural balance and poise. It is training that engages both mind and body together, each having its specific part, each is equally important. Lack of balance leads to maladjustments and disabilities. A body in balance functions with ease; without balance it functions with effort and inefficiently. A body not in balance can be restored to balance.

A series of six exercises to attain better balance are described. The last chapter is devoted to applications. —R. J. A.

ZIMMERMAN, O. T., AND LAVINE, IRWIN. *DDT Killer of Killers.* Dover, New Hampshire: Industrial Research Service, 1946. 180 p. $2.75.

Some of our most outstanding entomologists have always claimed that man's dominancy over the insect world is far from assured. They believe it is a real question as to which will ultimately dominate the earth—man or insects. And some experts on the radio have just informed us that 1947 will be unusually bad for insects. Be that as it may, man has a new ally to combat this invasion that he has only recently discovered—DDT.

As quite often happens, man had discovered DDT (chemical name dichloro-diphenyl-trichlorethane) in 1874 but its effect upon insects were only made known rather recently. That

the beneficial properties of many newly discovered substances are not immediately discovered has quite often happened. Nor should this cause us great chagrin—think of the many thousands of compounds and the many possible beneficial results they could have.

Zeidler, a German, first prepared DDT, but J. T. Geigy of Switzerland first discovered its possible insecticide properties in 1934. It was first used commercially to save the potato crop of Switzerland in 1939. It was introduced into the United States in 1942, and having such valuable military uses, civilian usuage was held to a minimum. Only last year was it made available in large amounts. It can be made rather cheaply and easily from chlorobenzene, Chloral or chloral hydrate, and sulfuric acid. DDT is insoluble in water, but soluble in petroleum products (kerosene). It is used as a liquid spray or in powder form mixed with talc or some other material.

Its important military use was against man's mortal enemies—the louse, fleas, ticks, and mosquitoes.

Black Death (Bubonic plague) once destroyed from one-fourth to a half of Europe's population. Bubonic plague and typhus have always been war partners. The role of yellow fever and malaria in war is common knowledge. DDT was most effectively used in combating the insects that cause these plague proportion diseases.

This book discusses these diseases, the discovery and uses of DDT and tells exactly how to use DDT (recipes given). Sodium fluoride and DDT are the only two insecticides that act effectively as both stomach and contact poisons for insects. DDT is not very toxic to man—rather large quantities having to be taken internally to act as a poison. In powder form it can be harmlessly dusted on the body. It is effective on most insects—mosquitoes, flies, most ants, lice, fleas, ticks, potato beetles, moths, termites, and so on. One of its great advantages is its effectiveness over long intervals of time and the requirement of very small amounts.

—R. J. A.

FISHBEIN, MORRIS (EDITOR). *Modern Home Medical Adviser.* Garden City, New York: Garden City Publishing Company, 1946. 907 p. $4.95.

Twenty-four well-known specialists have collaborated with Dr. Fishbein, Editor of the Journal of American Medical Association and author of numerous popular books on health such as *The New Medical Follies, Shattering Health Superstitions,* and *Fads and Quackery in Healing.*

Evidently the material presented in this book is about as accurate scientifically as possible. The language is non-technical and most readable. The symptoms and treatment of the most common diseases are discussed and explained. Vital facts that modern medical science has learned about cancer, heart diseases, diabetes, the common cold, hay fever, allergies, tuberculosis, arthritis, and so on are given interesting and authoritative treatment. Danger signals in yourself, relatives, and friends may be recognized before it is too late. Knowing what to do before the doctor arrives may be very important. This is not only an excellent book for the home and the individual but also is a fine source of material for the science teacher. The work is well illustrated and well indexed.

Among the many chapters there are chapters on diet, posture, nervous and mental disease, the skin, veneral disease, endocrinology, allergy, deficiency diseases, first aid, sex hygiene, and so on.

—C. L. D.

DE BOTH, JESSIE MARIE. *Modern Household Encyclopedia.* Chicago: J. G. Ferguson and Associates, 1946. 339 p. $3.00.

Over 8,000 hints and 200 illustrations make this an unusually fine household encyclopedia. It is alphabetized for easy study and quick reference. The reviewer was amazed by the vast amount of practical, authoritative information presented—a real storehouse of household information—all the way from recipes for cake making, roasting meats, cleaning fruits, jelly making, ways of stopping hiccoughs, cleaning silverware, what to do in electric shock, resting tired feet, fainting, painting, plant trouble, serving, and so on.

Life magazine is quoted as saying "Jessie De Both is the best known and best-paid cooking impressario in the country. She travels thousands of miles, writes millions of words, lectures, broadcasts—and in one big city after another puts on a show that amazes."

Her famed cooking schools draw audiences as high as 15,000. She originated the large-scale audience participating cooking school—and has conducted these schools in leading large cities everywhere. Her writings include 35 cook books with a combined sale of more than three and a half million copies. It may be said she has done more to influence the cooking, eating, and food-buying habits of the nation than perhaps any other individual of our times.

—R. J. A.

FIELDING, WILLIAM J. STRANGE. *Superstitions and Magical Practices.* Philadelphia: The Blakiston Company, 1945. 273 p. $1.00.

This is a ready reference on man's conduct, customs, folklore, and superstitions—past and present. Superstitions and unfounded beliefs have flourished in all primitive societies in every civilization and culture. In many ways Americans are less superstitious than they were a generation ago, but the extent of superstitions is much greater than most people suppose. In fact it is a very rare individual, even among the best educated, who does not carry around with him a pet superstition or so.

Science teachers and students will find this

a fine reference source either in teaching or studying, and quite likely they can easily add to the list. Chapter headings include: The Universality of Superstitions; The Magical Symbolism of Numbers, Signs, Omens and Warnings; Rings, Amulets, and Talismans; Gems and Precious Stones; The Sun and Other Heavenly Bodies; Mythology and the Calendar; The Magic of Taboo, Human Souls in Animal Bodies; Dreams and the Dream World; Courtship and the Betrothal; The Wedding and the Honeymoon, and Modern Survivals of Superstitions.

Science teachers should make it a specific aim to do something about unfounded beliefs in their classroom teaching. This is one area in which tangible results can be obtained as Caldwell and Lundeen proved experimentally a great many years ago.

—C. M. P.

EVANS, BERGEN. *The Natural History of Nonsense.* New York: Alfred A. Knopf, 1946. 275 p. $3.00.

This book is quite reminscent of the earlier Caldwell and Lundeen *Do You Believe It?* published in 1934. More than half of the content deals with superstitions and false beliefs in the field of science. As such the book is of peculiar interest to every science teacher and science student. The author in the preface calls it "A study in the paleontology of delusion. It is an antibody for all who are allergic to stardust. It is a manual of Chiropody for feet of clay." People know so much that "aint's so"! So often do we find people described by the author as "so colorfully, so militantly, so badly, so confidently wrong." Altogether the book is an entertaining and witty assault upon some of the more preposterous errors and legends that mankind insists on believing—a sort of believe it or not in reverse.

The work evidences much research and thought upon the part of the author. Almost every type of nonsense is described and the supporting facts for its falsity is given. Ideas of the Stone Age exist side by side with the latest scientific thought. This nonsense is found in almost every realm of man's thought and actions—beliefs about numbers, animals, plants, birth, death, racial characteristics, racial superiority of men over women, superiority of animals (in some aspect) over man, adopting of children by animals, disease, and so on. But the reviewer wonders about the slight reference to one of the greatest areas of American nonsense—fortune telling, astrology, the magic belief in the number games, games of chance, etc. Was this lack of mention due to the lack of space caused by the newsprint shortage? Surely *Nonsense* in these areas is more widespread and much harmful, and actually more ridiculous than in many areas described.

—C. M. P.

FRAPRIE, FRANK R., AND JORDAN, FRANKLIN I (EDITORS). *The American Annual of Photography.* Boston: American Photographic Publishing Company, 1946. 208 p. $2.00.

This is Volume 61 of the always interesting American Annual of the year's best photographs plus some of the best articles on photography by experienced photographers. Some of the articles and authors are, *The Electron Microscope,* by Cecil E. Hall; *How Many Developers,* by Allen R. Greenleaf; *Pictures,* by Eleanor Custis; *Photographing Historic Landmarks,* by Karl O. Townsend; *The Status of Color Photography for the Mass Market,* by Lloyd E. Varden; *The Gum Print,* by Theron Kilmer; *The Story of the Color Slide Salons,* by Jack Wright; *Cave Amateurs,* by Arthur Palme.

—C. M. P.

MCMANIGAL, J. W. *Marketing Your Pictures: How and Where.* New York: T. J. Maloney, Inc., 1946. 63 p. $1.00.

This is a book on selling free-lance photography. The author still lives at Horton, Kansas, where he was born. He has been unusually successful in selling his pictures. This book gives advice as to how to sell your pictures: how to get started, first markets, specialize! specialize!, what camera, the little markets, how much to charge salesmanship, releases—model trouble, dealing with syndicates, what material sells, photographic technique, many little things, a few specific cases, and can you do it?

This is a most practical and suggestive book for all amateur and beginning photographers even if you are not interested in selling your pictures.

—C. M. P.

SOOY, LOUISE, AND WOODBRIDGE, VIRGINIA. *Plan Your Own Home.* Stanford University: Stanford University Press, 1946. 246 p. $3.00.

Probably more homes will be built in 1947 than in any other year of American history. Many excellent books have appeared in the last year or so that will save the home-planner both money and disappointment. A prospective home builder should consult these books—each contain much sound, practical advice in building a home that most nearly meets one's taste and desires.

Plan Your Own Home is such a book. Practically all problems of home building are discussed—choosing a site, essentials of landscape, placing the furniture, working out color and decoration schemes, floors, window and heating arrangements, hallways, kitchens, dining rooms, living rooms, bedrooms, and so on. This is not so much a book on floor planning and construction details as it is a most valuable supplement to other books emphasizing the planning details. Both authors teach interior decorating at the University of California at Los Angeles and are writers and lectureres on the subject of home-making and interior decorating. So

unlike many other books on house planning and building, here you get the woman's point of view. —F. M. D.

GREEN, PAUL D., AND KITCHEN, RALPH. *Car Owner's Handbook.* New York: Duell, Sloan & Pearce, Inc., 1946. 192 p. $2.50.

This handbook stresses preventive maintenance rather than home repair. The writers first introduce car owners and drivers to the make-up and functions of the automobile: the "H" system of shifting gears, the instrument panel, electrical system, the fuel system, the cooling system, oiling system and lubrication, tires, brakes, steering system, and attention to appearances. Throughout the book are hundreds of hints on how to avoid foolish spending for parts that are unnecessary.

One section is devoted to safe driving—starting, stopping, parking, rules on the road and various kinds of driving. Whether just beginning to drive, or a driver of many year's experience, there is much of value to be learned from this handbook. It is an excellent book for courses in safety driving.

—C. M. P.

BELL, HARRIE A. *Getting the Right Start in Direct Advertising.* New York: Graphic Books, Inc., 1946. 161 p. $4.00.

This is a textbook written for beginners. Fundamentals are discussed, explained, and properly related to each other. Various types of direct advertising are explained, suggestions on writing copy, effects of color, postal information, and so on.

—C. L. D.

CERF, BENNETT. *Anything for a Laugh.* New York: Bantam Books, 1946. 220 p. $0.25.

This is a collection of over 500 stories, quips, and anecdotes, many about famous people by the author of the well-known *Try and Stop Me* and *Laughing Stock.*

—C. L. D.

ELLIOTT, R. N. *Nature's Law—The Secret of the Universe.* New York: 63 Wall St., R. N. Elliott, 1946, 64 p.

This is a loose-leaf booklet stating some theories of the author relating to what he calls nature's law which is based upon his concepts of rhythm, periodicity, and mathematical relationships in life activities—apparently operating in both individual and social life. Discussions refer, in the main, to the stock market, but with references to the Egyptian pyramids, Pythagoras, and Hersey—the last concerned with emotional cycles in people. Many diagrams and mathematical calculations abound in the 64 pages. The last page of the book advertises three services which the author will undertake to supply on application; and services in stock graphing furnished at stated prices by a distributor in New York.

—A. W. H.

STANDARD, STELLA. *More Than Cooking.* New York: The Vanguard Press, 1946. 275 p. $2.50.

This book should appeal both to the skillful cook and to the beginner—and both women and men. Directions are simple and the many recipes are well indexed for cross reference—so you can find what you want, when you want it. The book is good reading and will serve not only as a guide but also as an inspiration.

—R. J. A.

LEWIS, MONTGOMERY S. *Legends That Libel Lincoln.* New York: Rinehart and Company, 1946. 239 p. $2.75.

In the chapter about the father of Abraham Lincoln, *Thomas Lincoln—Average Pioneer,* the author states that the picture he has formed of Thomas Lincoln being an honest, kindly man, that did own and pay for land, a man that the neighbors respected and could depend upon—is based only in a small degree on the testimony of individuals. It is based on documentary evidence that has been uncovered by painstaking and patient research on the part of several people, foremost among whom is Dr. Louis A. Warren. Valuable contributions have been made by others, notably by Dr. William E. Barton and Ida M. Tarbell. Dr. Warren found over one hundred documents still in existence in Kentucky relating to Thomas Lincoln and in 1926 he published a book entitled *Lincoln's Parentage and Childhood.* Herndon, Dennis Hanks, J. Rogers Gore (*The Boyhood of Lincoln*) and others have made broad, misleading statements based on merely their own opinion, hearsay, or imagination. These statements and generalizations are not based upon fact and good authority. And it was from these that many biographers of Lincoln have gotten wrong impressions about Lincoln, his father, Thomas Lincoln, Ann Rutledge, Mary Todd, and Nancy Hanks, the Mother of Lincoln. As a result our whole history about Lincoln has become legendary and distorted and not based on sound documentary evidence.

Herndon liked contrasts and he advised Lamon to stress the contrast of Lincoln's father and Lincoln, playing the one down to make the other the more impressive. Then writers took liberties and made statements more disparaging than even those of Herndon. Thus, little by little, the legendary picture has been created.

The imagination of William H. Herndon ran wild when on November 16, 1866, he delivered his lecture entitled "Ann Rutledge, New Salem, Pioneering and the Poem," and really for the first time made the world conscious of the love story of Lincoln and Ann. Again Herndon's love for contrast and distortion won out. Lincoln loved Ann, but not so completely that it influenced his whole life. Nor was he so beside himself as to be almost insane after her death nor was he nearly insane two other times, nor did he inherit any such tendencies as Herndon

contended. In less than a year he proposed to Mary Owen and later to Mary Todd—in other words his love-affair with Ann was much overplayed, and the echo of this episode has come down through the years. Thus Mary Todd Lincoln stands in the minds of many people as the unloved wife of Abraham Lincoln, which to all intents and purposes was not true. The reader will find the chapters Mary Todd Lincoln—Her Springfield Years and Mary Todd Lincoln—The White House Years most interesting.

Through study and research in the life of Abraham Lincoln, Montgomery S. Lewis has found three major libels in the Lincoln story. These he has determined to correct, which is the purpose of this book. —F. M. D.

GOODSPEED, CHARLES E. *A Treasury of Fishing Stories.* New York: A. S. Barnes and Company, 1946. 600 p. $5.00.

The author has selected one hundred and seven stories, many from well known writers—Audubon, Jerome, Melville, Thoreau, Butler, Irving, Mather, Beecher, Longfellow, VanDyke, Stockton, Bradley, Grey, and so on. This is really a wonderful collection of stories—entertainment, refreshment, good sport, folk lore, and so on. You even find here the tall-story tellers, the liars, and the romancers. The book opens with the greatest and best known fishing story of all times—the Disciples Fishing in the Sea of Galilee. Altogether it is more than a collection of fishing stories—it is a fine contribution to anthological literature. It would serve very well as a supplementary reading for biology students—entertaining and informative. It is an excellent addition to the high school science library.

The author is an ardent fisherman and an eminent Boston bibliophile and book seller. He is author of *Angling in America.* —C. L. D.

THE JEWISH BLACK BOOK COMMITTEE. *The Black Book.* New York: Duell, Sloan and Pearce, Inc., 1946. 560 p. $5.00.

The Black Book is a record of the Nazi Crime against the Jewish people. Here is compiled and recorded all of the evidence, supported by the official records of the Nazi leaders themselves and the testimony of innumerable eye-witnesses. It is a record that the German people cannot live down nor the world forget in the "next thousand years" as Hitler so ranted about in emphasizing quite a different remembrance. Nor can civilization itself look back in the future years and put on a cloak of indignant righteousness. For in many ways, weaknesses in the moral structure of our present civilization were at least a partial contribution to this blackest mark of the twentieth century world. Emphasis is placed on the guilt of the whole German people—not only on the leaders who carried out the unbelievable and almost unimaginable atrocities. For the German people to plead ignorance of any knowledge of the high crimes is too much for any thinking person. They could not have escaped knowing and so shoulder much of the actual responsibilities. They stand as guilty participants.

The volume is based on much technical skill and exhaustive research. Official documents of the Nazi leaders, newspaper and magazine articles, government and military orders are all carefully and completely presented. The entire manuscript of *The Black Book* was submitted to the United Nations War Crimes Commission meeting at Nuremberg, Germany.

Two out of every three European Jews were exterminated. Extermination Camps were very numerous. Some of the mass camps were: Buhenwald, Dachau, Treblinka, Warsaw, Sobibur, Bergen-Belsen, Maidenek, Oswiecim, Birkenau, and so on. At Birkenau alone about 1,765,000 Jews were gassed. At Oswiecism and its subsidiary camps—four million Jews—almost two-thirds of the 6 million persons who perished in Europe at the hands of the Nazis—were murdered. Lest we forget! —C. M. P.

KNAUTH, PERCY. *Germany in Defeat.* New York: Alfred A. Knopf, 1946. 233 p. $2.75.

Germany is now a wilderness of smashed houses and chaotic social institutions. It is a land of misery, savagery, and bewilderment. This is the portrait of the Reich which was supposed to last a thousand years. Percy Knauth, the author of this excellent book, is the bureau chief of the Paris office of Time. Mr. Knauth went into Germany in March, 1945. Knauth was born in Flushing, New York in 1914. He has lived or traveled in most of the countries of Europe.

This book I find is really made up of a series of portraits or pictures painted in words most vivid and meaningful. He happened to go to the home of a young woman whom he had known since they were children. She was living all alone with her small child—her husband was then in the service. She remarked that she would wait there with her child till the war was over, which should not be long now she said and her husband would be home. "If he doesn't I will kill myself and Mischa (her child). I don't see why the two of us should go on living if he doesn't come home—Es ist ja alles verspiett —everything has been gambled away." How true is her statement, "everything gambled away." This should be a lesson to all Americans who read this book for aren't we also in great danger of following bad leadership or being drug down by those whose loyalties are elsewhere, and see our great nation, the United States ruined—our wonderful heritage gambled away. This friend of Knauth now had to suffer along with all the rest, although she had not joined up with youth organizations and other organizations—and all the propaganda devices of the Nazis and Hitler were shunned by her. She was ahead of her time and like many others

in Germany saw that the Nazi party and the socialistic doctrine they preached of getting something for nothing—that the world owed them a living, was a false doctrine and would lead to nothing but to the defeat and ruin which it did.

She expresses the thoughts no doubt of many young German men and women today, when she asks the question, "What have I had out of life? I was fifteen when the Nazis came. That is a happy age for girls, but I don't remember any happiness. I never joined the B.D.M., I never wanted to have anything to do with their youth movements. I can't remember that I have ever been free from a sense of doom about this country since the Nazis came. They ruined what they touched, and they ruined us, too—we knew they would." Another lesson Americans should learn from this book is that we should be sure that men elected to high public office in Washington, or those appointed to government posts are loyal to the best interest of our country over and above that of any other country. Hitler's Berchtesgaden quarters had a very large window which looked away into the country of his birth, Austria. Had Germany been the land where he was born, had it really been his fatherland would he have put his own lust for power above everything else and gambled everything away to the utter ruin and defeat of Germany? He and the Nazis betrayed the German people and put their own selfish lusts and desires above that of the people.

The Kaiser, mean and cruel as he was, did not want to see Germany in ruins, and as well we all recall, surrendered in time to prevent that. There are twelve chapters in the book and each of them is a complete word-picture of the ruins, ruined cities, concentration camps, destroyed factories, and homes. The author reveals to the reader both the outer face and the inner character of the broken Reich.

—F. M. D.

CARRINGTON, HEREWARD. *The Invisible World.* New York: The Beechhurst Press, 1946. 187 p. $2.50.

The author is Director of the American Psychical Institute and has had forty-five years of experience in the field of psychical research. The material presented is entertaining and thought-provoking and seemingly the author has consciously tried to make it factual and authenticated. He relates the facts as he has observed them and leaves the reader to form his own conclusions. The New York Times characterizes the work of Dr. Carrington as "scholarly, scientific, and impartial". He was a member of the Scientific American Committee that made the famous investigations in this area several years ago. The author believes that the study of psychical phenomena some day will be regarded as a fully accepted science. He readily admits that we are only at the fringe now and actually know very little. Much of the present scepticism is because of the pseudo and fraudulent work in the past.

The author discusses many of his own investigations, great mediums and great frauds of the past, and experiments and investigations that may be made in the future. The phenomena described here are quite different from the J. B. Rhine extra sensory perception experiments at Duke University. —C. M. P.

MCMEEKIN, ISABEL MCLENNA. *Louisville: The Gateway City.* New York: Julian Messner, Inc., 1946. 279 p. $3.00.

In 1819 Dr. McCurtrie, in his history of Louisville, predicted that unless the town was cleaned up it would be visited by a scourage of bilious fever not very different from the yellow fever of the tropics. Three years later, the most disastrous calamity came and in some instances it swept away every member of the family. Then ponds were drained and filth cleaned up. In draining the ponds, they lost these recreational spots, for on the ponds happy skating parties were held in the winter. The boys pulled chairs on which the girls were seated, the backs of the chairs being laid flat on the ice and served the purpose of sleds. In one instance an Indian mound was used in filling in a pond. The mound, though about fifteen feet high, was some hundred feet in circumference. In doing this work many prehistoric relics were uncovered as well as human skeletons. In another instance a mound yielded flint arrowheads, stone axes and bits of pottery which would have been gold mines to later archeologists. These relics were carelessly discarded or used to raise the level of the street.

Distinguished visitors came to Louisville during June of 1819, President James Monroe and General Andrew Jackson, attended by their suites. Six years after this General Lafayette came to Louisville.

The fastest boat on the Ohio, broke the speed record by coming up the river from New Orleans to Shippingport in seventeen days. There were sixty-eight boats on the river at this time. The luxury of cabin passage was only for the rich, for it cost a hundred and twenty-eight dollars to go from Louisville to New Orleans. When Louisville was declared a city in 1828, a fresh impetus was given to intellectual life, and culture (with a capital C) was pursued (if not undertaken) by the ladies of the town, many of whom now owned slaves or employed country girls to take over the heavier work of their households. The town was very definitely sloughing off its pioneer ways.

George Keats, the brother of John the poet, built a fine mansion which was known as the English Palace. A sister of Stephen A. Foster visited her kinsfold the Barclays, in Louisville at whose house she contracted a fever and died. She was buried in the Bullit family plot, but the body was later taken to Pittsburgh. About this time the powers-that-be were in a swivet

over a rat menace, not just ordinary rodents, but huge gray creatures from Norway which had worked themselves up the river from the port of New Orleans. A bounty per head was offered in order to rid the town of rats.

Most of the people of Louisville are English born, only 8 per cent being foreign born. What really put Louisville on the map was the building of Camp Zachary Taylor a short distance out of town. Workmen, students, and others helped the increase in population until it grew in population from a little city to a big city. Camp Henry Knox was also part of the local picture during World War I.

In the fall of 1918 the flu epidemic descended on Camp Taylor and out of 13,000 men, 824 died. Of World War I the author writes, "At last came peace, preceded by the false armistice, when Louisville, along with the rest of the country, whooped it up, in contrast to the quiet observance of V-E Day."

Now that World War II is over, many newcomers may become permanent residents of Louisville and help build toward the future with the same faith and vision that inspired the early settlers, who settled there at the falls of the Ohio more than a hundred and fifty years ago.

Louisville is a *Cities of America* biography series book. It will be found excellent for supplementary purposes in history, social studies, geography, and political science. Along with a bibliography and other information given in the back of the book is a list of all the Derby winners from 1875 to 1945. —F. M. D.

HANSON, JOSEPH MILLS. *The Conquest of the Missouri.* New York: Murray Hill Books, Inc., 1946. 458 p. $3.50.

This is the story of the opening of the Northwest as seen through the eyes of Captain Grant Marsh, one of the greatest river pilots ever to navigate the shoals and rapids of the Big Muddy. Frequently in the old days his wood-burning stern wheelers were the only link between lonely communities and the rest of civilization.

A most interesting narrative, the book is replete with stories of romance and exciting adventure.

The story of "Cupid at the Apple-Butter Stirring," is a good old fashioned love story told as only a good story-teller or writer can tell a story. Grant Marsh, the hero of this story, also met up with another most interesting person who was the second pilot on A. B. Chambers No. 2, a Missouri river boat. The reader will enjoy this story, as well as the one about "The Battle Morn of Shiloh." The next day Marsh and others, "had walked a mile or more from the river, finding the way strewn with many dead and wounded men to remind them of the dreadful struggle just over; 600 wounded men on board the John J. Roe, principally Indianians, were taken to Evansville—the remainder being Missouri troops, were taken on to St. Louis."

Captain Marsh was in command of the North Alabama, a river boat, taking vegetables to Camp Buford. Cold weather set in and fires were necessary to keep the vegetables from freezing. Finally the Indian scouts got word from Marsh to Camp Buford, and covered wagons with fires in them were dispatched to get the vegetables. For Captain Marsh's care to get the vegetables through safely to the fort, he was highly commended by the military authorities, and the officers and soldiers at Fort Buford ever after held for him a warm friendship.

A map of the upper Missouri river area, photographs and bibliography add to the usefulness of the book. In all Captain Marsh worked sixty-three years on the rivers of the West.

—F. M. D.

O'BRIEN, JOHN A. *Truths Men Live By.* New York: The Macmillan Company, 1946. 427 p. $2.75.

The author is Professor of the Philosophy of Religion at the University of Notre Dame. A student at Oxford University and holder of a Ph.D. from the University of Illinois, he was for 22 years the Director of the Newman Foundation at Illinois. Thus back of this book is 30 years of teaching, much writing and extensive travels. In this book the author discusses the basic religious and moral truths men live by. He believes it is folly to deny the far-reaching repercussions of modern scientific research upon various phases of theistic thought. Dr. O'Brien states that the harmonization of religious faith with modern science must be effected with no compromise of intellectual honesty. He discusses the Bible and Science at some length, especially creation and evolution. In common with most outstanding religious leaders of all faiths as well as many scientists, he sees no conflict between the two when each is correctly interpreted. —C. M. P.

ARCIMEGAS, GERMAN. *Caribbean: Sea of the New World.* New York: Alfred A. Knopf, 1946. 464 p. $3.75.

At the time the book was published, the author was Minister of National Education of the Republic of Colombia. The author states that during the years of 1943 and 1944 while on visiting professorships, at the University of Chicago, Mills College, and the University of California, it was possible for him to write this book. He had the plan of the book in mind for years. He further states that at the University of California, thanks to its splendid library of Latin American History, he found advice and material necessary for the completion of his work.

More than four centuries leading up to the twentieth century are historically described. Much of the history is built around the lives of Columbus, Amerigo Vespucci, Cortes, and other

early explorers of the Golden Age. The life of Queen Elizabeth and that of Sir Walter Raleigh and young Essex are most interesting. Then in narrating about the pirates, smuggling in the Gulf of Mexico at the port of New Orleans and their many sojourns, is another interesting period in the history of the Carribbean. Lafitte, who sold his slaves for one dollar a pound; Bolivar and Miranda great lovers of liberty; and the story of Audubon are some of the highlights. Tumults, riots, revolutions it seems as Miranda said "is all these people know." The Panama Canal, the work of De Lesseps and the part played by Theodore Roosevelt, further bears out the turbulency of the history of the Spanish peoples both in the old world and the new.

There are sixteen photographs in the book among which are excellent pictures of Ferdinand De Lesseps and Josephine, Empress of the French. In the back of the book is an excellent bibliography on Latin America and a chronology of events in the old and new world from 1451 to 1903. An index further increases the use and value of the book for research and historical study. —F. M. D.

OJIKE, MBONU. *My Africa.* New York: The John Day Company, 1946. 350 p. $3.75.

This is a John Day 20th Anniversary Book. The author, a native of Nigeria, Africa, states there are some five different zones in Africa, and it is the "animal zone" that has been written most about. The people of Nigeria are paternalistic, and may be descendants of the Paraohs of Egypt. They are clannish and in many respects resemble tribal life in other parts of the world. As to the basic needs of man: food, clothing, shelter, fuel, tools and implements, Ojike was as well off as many other children throughout the world and like many other rural boys and girls he had to assert himself and struggle in order to get an education.

Missionaries, no doubt, helped his people, but like Ojike, we agree that insisting when converted that the individual should be given a new Christian name was not wise. To plant where the culture is and help others without hurting them, or to make improvements without attempting to standardize should be the aim. Universally, we like our people and the environment we are born into, and to the extent that we like it just as it is, we may become conservative, and it is young men like Ojike, returning to Africa at thirty years of age, that are now most able to help their own people. He had received a liberal education before he came to America when he was twenty-four years of age. These are days of give-and-take as to cultures. "But," he states, "without self-respect and mutual respect, our exchanges will be stupid and dangerous."

I think Ojike will make it more difficult for his people to be exploited politically and economically. He has learned the value of Nigeria's and Africa's many valuable mineral and vegetable resources of which he gives a complete list. He tells where the materials can be found and the use that can be made of each.

There are a series of photographs, and in the back of the book is a list of Western museums preserving African art, a list of important dates, and what happened at that time in African history; a list of leading African newspapers, an annotated book list about Africa and the Negro, and an index.

On the basis of per capita nutrition, Africans are one of the best fed peoples in the world. Three good meals a day is about the only social creed any African can recite. He doesn't want to lose weight or look too thin, because people might conclude that his is so lazy he could not produce enough food to eat.

I would like to tell Ojike that it is rare that a man in the United States cooks a meal or the meals and does kitchen work while his wife works, waits, or looks on.

The author states that in post-war Africa there will be a greater demand for better agriculture, more industry, bigger trade and a generally higher standard of living.

While in the United States, Mbonu Ojike earned a B.S. degree at Ohio State University and a Masters' Degree in Education and Administration at the University of Chicago.
—F. M. D.

STONE, WILLIAM S. *Tahiti Landfall.* New York: William Morrow & Company, 1946. 308 p. $3.50.

The author has been a resident of Tahiti since 1936. As a place to live, he describes it as a paradise that rivals the land of the lotus eaters. He describes the beauty and color of this south sea island where the mountains rise sharply out of deep blue lagoons. The people live a life of ease, but also one of fun and excitement, too.

Mr. Stone's own home is managed by Taval and Teuru—brother and sister—charming and irresponsible. From Tahiti, the author takes the reader to a possible even lovelier island—Huahine—well off the beaten tourist path.

This is a very enjoyable book for all those who like to read travel books and about peoples of far away lands—how they live, think, and carry on their everyday activities, often unhampered and almost oblivious of the rest of the world that calls itself civilized.
—R. J. A.

COE, DOUGLASS. *The Burma Road.* New York: Julian Messner, Inc., 1946. 192 p. $2.50.

This tells in brief the changes in ruling powers in China for a period of over 3,000 years and in detail the story of the construction of the road that linked China with the rest of the world when Japan cut off all her ocean ports in the last war. It is a thrilling story from beginning to end. There are interesting illustrations.
—W. G. W.